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# Integrated classroom physical activity: Examining perceived need satisfaction and academic performance in children

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**Integrated classroom physical activity: Examining perceived need satisfaction and  
academic performance in children**

by

Miriam Ann Blom Skrade

A thesis submitted to the graduate faculty

In partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE

Major: Kinesiology

Program of Study Committee:  
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Iowa State University  
Ames, Iowa  
2013

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## TABLE OF CONTENTS

LIST OF FIGURES .....	iv
LIST OF TABLES .....	v
ACKNOWLEDGEMENTS .....	vi
ABSTRACT .....	vii
CHAPTER 1 INTRODUCTION .....	1
CHAPTER 2 LITERATURE REVIEW .....	6
The Need for Increasing Physical Activity .....	6
Classroom-Based Physical Activity Interventions .....	9
Health Benefits from CBPA .....	13
Learning Benefits from CBPA .....	18
Academic Motivation .....	23
CHAPTER 3 METHODS .....	28
Participants and Setting .....	28
Measures .....	29
Demographics .....	29
Teacher log .....	29
Math Performance (MP) .....	29
Basic Need Satisfaction from Math .....	30
Basic Need Satisfaction from Integrated Physical Activity (IntPA) with Math .....	31
Procedure .....	31
Move for Thought .....	33
Intervention .....	34

Data Analysis .....	35
CHAPTER 4 RESULTS .....	37
Intervention Fidelity .....	37
Reliability Analysis .....	38
Descriptive Statistics .....	39
Changes in Outcome Measures .....	43
Baseline Differences Between the Classes .....	43
Academic/Math Performance .....	43
Math Basic Need Satisfaction .....	45
Relationship of Motivational Variables to Math Achievement .....	45
CHAPTER 5 DISCUSSION .....	48
Conclusion .....	54
REFERENCES .....	55
APPENDIX A Factors and Questions used for Basic Need Satisfaction Surveys .....	63
APPENDIX B Teacher Log .....	64
APPENDIX C Comprehensive Fourth Grade Math Test .....	65
APPENDIX D Comprehensive Fifth Grade Math Test .....	69
APPENDIX E Move for Thought Kit .....	73

**LIST OF FIGURES**

Figure 1. Classroom-based physical activity intervention lengths .....	12
Figure 2. Mean percentage math performance score and standard errors for M4T classes and traditional classes over time .....	44

## LIST OF TABLES

Table 1. Sample Characteristics, Iowa, 2012.....	38
Table 2. M4T and Traditional Students' Perceptions of Three Basic Needs for Math ....	39
Table 3. M4T Perceptions of Three Basic Needs for the Integrated Physical Activities.	40
Table 4. Correlations among Math and Integrated Physical Activities Basic Need Satisfaction and Math Performance .....	42
Table 5. Mixed Model Analysis of Covariance (ANCOVA) for Math Performance as a Function of Time and Group.....	45
Table 6. Hierarchical regression analysis of Math Performance post-test score. ....	47

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## ABSTRACT

Physical activity is related to better academic performance and prevention of childhood obesity. Classroom-based physical activities, based on recent research studies, seem to target both areas successfully. Move for Thought (M4T) is a recently developed kit that integrates physical activities into academic lessons in the classroom. This thesis is the first to examine the kit's impact on children's motivation and math performance. The study aimed to see (a) if eight weeks of M4T integrated with math, compared to traditional lessons (control), would elicit a gain in math performance and (b) if the basic psychological needs in math (autonomy, relatedness, and competence, based on Self-Determination theory) were perceived satisfied and would predict math performance. Seven fourth grade teachers utilized M4T ( $N = 106$ ) and seven fifth grade classes did traditional lessons ( $N = 118$ ). Teacher log entries indicated that intervention classes used the M4T kit an average of 20-25 minutes per week. Student's overall motivation in math as well as a timed math test was completed pre and post intervention period for both groups. Need satisfaction from the implementation of the M4T activities was also measured at the culmination. Results showed that the improvement in math performance for the M4T group was significantly higher (time x group interaction;  $F = 17.51, p = 0.000$ ) compared to the control group. Students' perceived competence for math in general positively and significantly predicted math performance after the implementation period ( $\beta = 0.42, p = 0.000$ ). Subsequent intervention analysis of need satisfaction specifically for the classroom-based physical activity group showed that perceived



competence toward M4T significantly predicted ( $\beta = 0.22, p = 0.004$ ) post-test math performance above the contribution of pre-test math needs satisfaction. The results showed that integrated physical activity with math in the classroom can improve math test scores directly as well as through higher perceived competence. Results demonstrate that M4T can be beneficial for both teachers (who strive to meet the constantly increasing standards for performance) and students (who struggle to maintain high motivation and learn effectively). As a new kit and a new approach, further exploration needs to be conducted about its usability.

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## **CHAPTER 1**

### **INTRODUCTION**

The prevalence of overweight and obese children is rapidly and constantly growing, of which all socioeconomic levels and ethnicities are affected (Ogden, Carroll, Curtin, Lam, & Flegal, 2010). Excessive weight and physical inactivity are associated with higher mortality, higher prevalence of chronic disease, and psychosocial constraints even before adulthood is reached (Daniels et al., 2005; Hu et al., 2004). The Surgeon General reported the ‘key modifiable risk factors [for obesity] are physical activity (PA), sedentary behavior and diet’ (U.S. Department of Health and Human Services, 2010). In a 2012 report entitled *Designed to Move*, researchers aiming to stop the epidemic of physical inactivity declared the framework for action is to ‘create early positive experiences for children [related to PA]’ and ‘integrate physical activity into everyday life’ (Nike, American College of Sports Medicine, & International Council of Science & Physical Education, 2012). Promotion of positive health-related behavior early in life is expected to carry over into adulthood (Singh, Mulder, Twisk, Van Mechelen, & Chinapaw, 2008). Research has shown that active children are more likely to become active adults (Pate, Baranowski, & Trost, 1996).

Schools have the potential to positively influence children’s PA levels, yet legislative pressures related to stringent academic requirements and limited school budgets, have resulted in children receiving significantly less time for PA during the school day than they did even a decade earlier (Fedewa & Ahn, 2011). In response,

hundreds of school-based interventions have been implemented to combat this trend and address the need for increased PA among school-aged children. Examples of school-based interventions include: mandatory physical education, classroom activity breaks, after-school activity programs, walk-to-school programs, modified playgrounds, and modified recess. They all strive to increase PA, however, their benefit to overall PA is not equal.

Classroom-based physical activity (CBPA) was recently rated the second most effective intervention for increasing PA for elementary and middle school students (Basset et al., 2013). CBPA is a new, innovative way to reach youth where they spend the most time. As the name suggests, CBPAs are any PA done under the direction of the classroom teacher, while in the same classroom as the academic subjects. CBPAs that are unrelated to subject content are considered Activity Breaks while Integrated Physical Activities (IntPA) incorporate academic content with the movement. Both activity types are designed with an awareness of space constraints, and thus, creatively finds ways to get children out of their seats and moving for five-twenty minutes. Teachers have reported the CBPA programs as easy to implement, require minimum prep time, and their students enjoy the activities (Stewart, Dennison, Kohl, & Doyle, 2004). Several CBPA interventions have been successfully implemented and new adaptations are coming forth, which will all be described below.

Currently, there are over 25 studies that have assessed the effect of CBPA on academic behavior and performance, cognitive function, and physical activity levels. Most CBPA intervention studies have demonstrated that CBPAs elicit significant

increases in PA (Ahamed et al., 2007; Bartholomew & Jowers, 2011; Donnelly et al., 2009; Goffreda, 2010; Kriemler et al., 2010; Jurg, Kremer, Candel, Vanderwal, & De Meij, 2006; Mahar et al., 2006; Reed et al., 2010; Stewart et al., 2004; Trost, Fees, & Dzewaltowski, 2008). Health benefits are most often implicit in PA interventions, however some CBPA studies have been able to directly show decreased skinfold measurements (Kriemeler et al., 2010), attenuated body mass index (Donnelly et al., 2009), and osteoporosis prevention (Macdonald, Kontulainen, Khan, & McKay, 2007; McKay, MacLean, & Petit, 2004). While the research is still relatively new, research to date has also shown physical activity in the classroom to enhance or, at a minimum, not hinder academic achievement. For example, Donnelly et al. (2009) followed 11 intervention schools and 11 control schools for three years and found classrooms using the Physical Activity Across the Curriculum Program (PAAC) performed significantly better than the control schools in reading, math, spelling, and composite achievement. While others have also directly found either significant improvements or no impairments in academic performance (Reed et al, 2010; Vazou, Andre, Schaben, Whigham & Welk, under review), some have measured academic performance predictors such as concentration (Maeda & Randall, 2003; Norlander, Moas, & Archer, 2005) and on-task behavior (Grieco, Jowers, & Bartholomew, 2009; Mahar et al., 2006).

Motivation is another important predictor of students' academic (Burton, Lydon, D'Alessandro, & Koestner, 2006; Gottfried, 1985), which is underexplored with CBPA. Vazou, Gavrilou, Mamalaki, Papanastasious, and Sioumala (2012) is the only study to date that has assessed students' task-specific subjective motivational experiences in

response to active and traditional academic lessons. Results demonstrated that integrating PAs with academic subjects can significantly increase children's intrinsic motivation, perceived competence, and effort, without enhancing perceptions of pressure and negatively affecting the value of the lesson, compared to traditional lessons. However, further research is needed to confirm these initial findings.

One of the newest activity packages is the Move for Thought (M4T), a physical activity package for any elementary or middle school grade level that can be integrated with any academic subject area. The kit can be used to target aerobic fitness, enhance academic performance, and promote motivation for learning and physical activity, however, since it was recently developed, its' effectiveness and impact on students' motivation and performance has not been examined. If the activities do not motivate the students to participate, then students will complain and refuse to participate, or will participate without any desire or enthusiasm. In that case, participation will drop and the implementation of the classroom-based physical activities will be diminished. Grounded on self-determination theory (Deci & Ryan, 2000), the satisfaction of the basic psychological needs, named competence, autonomy and relatedness, is considered a good indicator of someone's motivation.

Thus, the purpose of this thesis was to examine the impact the "Move for Thought" kit has when implemented in the classroom on students' math performance, academic/math need satisfaction and need satisfaction related to the instruction strategy (i.e., implementing physical activity with the academic content).

It was hypothesized that:

- a) math performance and motivation in the academic classrooms that implemented the Move for Thought activities for eight weeks will improve to a greater extent than in the traditional classrooms,
- b) use of Move for Thought activities in the academic classroom will enhance (or not adversely impact) perceived competence, autonomy, and relatedness, and
- c) perceived competence, autonomy, and relatedness will be significant predictors of math performance.

## **CHAPTER 2**

### **LITERATURE REVIEW**

#### **The Need for Increasing Physical Activity**

The prevalence of overweight and obese children is rapidly and constantly growing, of which all socioeconomic levels and ethnicities are affected (Ogden, et al., 2010). One of the main causes of increased obesity is the decrease in physical activity (Must & Tybor, 2005; CDC, 2004; Pate et al., 1996). Excessive weight and physical inactivity are associated with higher mortality, higher prevalence of chronic disease, and psychosocial constraints even before adulthood is reached (Daniels et al., 2005; Hu et al., 2004). The human toll from physical inactivity is expected to rise sharply with an already 5.3 million premature deaths attributed indirectly and directly to inactivity (Lee, Burgeson, Fulton, & Spain, 2012).

In a 2012 report entitled *Designed to Move*, researchers aiming to stop the epidemic of inactivity declared the framework for action is to ‘create early positive experiences for children [related to physical activity]’ and ‘integrate physical activity into everyday life’ (Nike et al., 2012). Promotion of positive health related behavior early in life is expected to carry over into adulthood (Singh et al., 2008). Research has shown that active children are more likely to become active adults (Pate et al., 1996). Unfortunately the opposite is also true with approximately 80% of children who were overweight at ages 10 to 15 were obese adults at age 25 (Whitaker, Wright, Pepe, Seidel, & Dietz, 1997) which reinforces the importance of youth PA.

The Physical Activity Guidelines Advisory Committee (2008) states ‘when youth participate in at least 60 min of physical activity (PA) every day, health benefits accrue, such as healthy bones and muscles, improved muscular strength and endurance, reduced risk for developing chronic disease risk factors, improved self-esteem, and reduced stress and anxiety’. While 60 minutes a day might seem like a lot, total exercise time, as explained by the National Association for Sport and Physical Education (NASPE), can be broken up into exercise bouts lasting 15 minutes or more (2004). Despite the ability to accumulate 60 minutes of PA, only 42% of U.S. children aged six-eleven years do and fewer than 8% of U.S. adolescents achieve this goal (Troiano et al., 2008).

Any amount of PA is better than none (Physical Activity Guidelines for Americans, 2008), and that is why the NASPE, along with other national standard organizations, discourage periods of inactivity for more than two hours. Media such as watching television, playing video games, and computer use are primary culprits for extended sedentary time in our current culture. According to Anderson et al. (1998) 67% of US children watched at least two hours of television per day and are inadequately vigorously active. Anderson was able to show that boys and girls who watch four or more hours of television each day had greater body fat and body mass index. Ten years later, Roberts and Foehr found the average American eight-to-eighteen years old reported more than six hours of daily media use (2008).

If children are doing more sedentary activities outside of school it becomes increasingly critical to reduce extended sitting time during their school day. Children spend an average of seven hours a day at school. With over half of children’s awake



hours being spent at school it is imperative to carefully consider how to allocate active and inactive time. Furthermore, schools serve as an effective avenue for change with access to large numbers of children from various income, cultural, and behavioral backgrounds.

Physical education (PE) has historically been the main opportunity for active time in schools. Yet, only 50% of elementary school and 25% of middle schools nationwide require PE (Burgeson, Wechsler, Brener, Young, & Spain, 2001), and less than 3.8% of American schools provide children with a daily PE (Lee et al., 2007). Physical Activity Guidelines state that at least 50% of PE time needs to be spent in moderate-vigorous PA (2008). While that is the recommendation, actual activity time during PE will vary from teacher to teacher.

Recess is another time students have the potential to be physically active. Relying on recess for physical activity requirements, however, presents several uncertainties. First, because recess is discretionary time some children may spend the majority of recess doing moderate-vigorous activity, while others may find a quiet spot to sit with a friend. In a study by Ridgers, Stratton, and Fairclough (2005), over 200 students had their PA time during recess quantified using accelerometers. They found that boys engaged in higher intensity activities than girls and on average, all children spent less than half their recess time physically active (Ridgers et al., 2005).

The second reason recess is not a reliable source of PA is that the amount of time dedicated to recess is declining. In a Texas survey, 24% of elementary school teachers reported no recess in their school, 68% reported once a day, 6% twice a day, and 1%

three times a day. Reported recess lengths also varied, with 12% reporting 1-10 min, 49% reporting 11-20 min, and 18% reporting 21 minutes or more (Zhu, Boiarskaia, Welk, & Meredith, 2010).

The third problem with relying on recess for physical activity guidelines is that traditional recess does not elicit as much energy expenditure as structured physical activity breaks (Scruggs, Beveridge, & Watson, 2003). Furthermore, Bassett et al. (2013) compared the effectiveness of various school-based policies and built-environment changes that aimed to increase students' energy expenditure throughout the day. Modifying recess with more games and playground equipment did elicit more energy expenditure, but not nearly to the extent of afterschool activity programs, walking/biking to school, classroom activity breaks, or mandatory PE.

Overall, due to legislative pressures, children receive significantly less time for PA during the school day than they did even a decade earlier (Fedewa & Ahn 2011). Hundreds of school-based interventions have been implemented to combat this trend and address the need for increased PA among school-aged children. Subsequent sections will illustrate that increased time for PA is actually synergistic to legislative concerns about students' academic performance rather than antagonistic and it is not limited to PE and recess.

### **Classroom-Based Physical Activity Interventions**

Classroom-based physical activity (CBPA) is a new, innovative way to reach youth where they spend the most time. As the name suggests, CBPA's are any PA done under the direction of the classroom teacher, while in the same classroom as the academic

subjects. The activities are designed with an awareness of space constraints, and thus, creatively finds ways to get children out of their seats and moving. Activities can focus on anything from increasing energy expenditure, developing flexibility, improving coordination, muscle strengthening, bone strengthening, or a combination.

There are two main styles of CBPAs: Activity Breaks (AB) and Integrated Physical Activities (IntPA). The breaks consist of PAs unrelated to subject content and serve to stimulate and reenergize students for the next lesson or break-up a long learning task. IntPAs, on the other hand, incorporate academic content with the movement and can be done with most subject areas. These activities can be used to learn a new concept, practice previously learned material, or review before an exam. Both CBPA styles typically aim to get students out of their seats for five-twenty minutes with an average activity lasting 10 minutes.

Several CBPA programs exist and are available to schools. Take 10!, for instance, has an in-depth website and offers a kit for purchase. Of the first programs that were available and freely accessed by the internet were the Energizers and the Brain Breaks. Recommended grade levels are associated with each activity with subject specific suggestions. Physical Activity Across the Curriculum (PAAC) is similar to Take 10! and promotes 90 minutes per week of active academic lessons. The P.L.A.Y. (Promoting Lifestyle Activity for Youth) program is catered for fourth-eighth grade and available for teachers upon request. Action Schools! BC is similar and takes instructors, administrators, or the public through a step-by-step description of how to implement the program. Activity Bursts in the Classroom for Fitness (ABC for Fitness) are bursts

spread out during the day during time teachers would ordinarily spend settling students down or getting them back on task. Several other programs such as Kinder-Sportstudies (KISS), The Class Moves!, and Move and Learn have been developed but they are not available through the internet.

Teachers have reported the CBPA programs as easy to implement, require minimum prep time, and their students enjoy the activities (Stewart et al., 2004). In a pilot study done in Scotland and Wales, pupils and teachers perceived *The Class Moves!* CBPA as innovative, interesting and enjoyable (Lowden, Powney, Davidson, & James, 2001). The PA sessions can be incorporated by teachers with low-cost and minimal disruption (Goffreda, 2010). Most researchers would agree with Stewart et al. (2004) that PA compliments rather than distracts from learning, appeals to multiple learning styles, and does not require extra staff or extensive training.

Currently, there are over 25 studies that have assessed the effect of CBPA on academic behavior and performance, cognitive function, and physical activity levels. The lengths of a select number of studies are depicted in Figure 1 (below). In the next sections, I will describe the health benefits that have been found followed by the learning benefits, and will finish by discussion how academic motivation is important and underexplored in relational to CBPA.

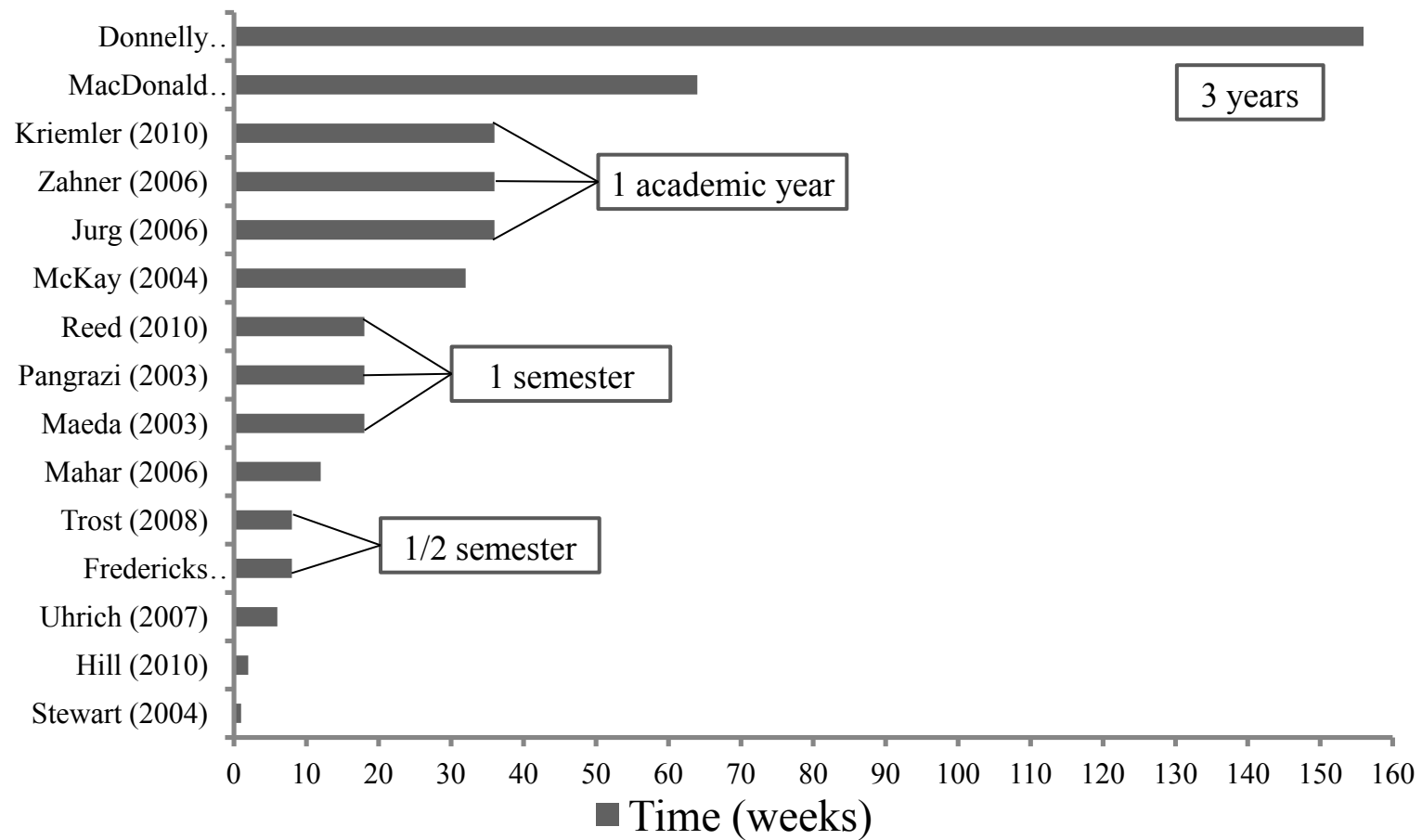


Figure 1. Classroom-based physical activity intervention lengths

### **Health Benefits from CBPA**

As stated earlier, despite the evidence that 60 minutes per day of PA is associated with several health benefits in children, PA levels among youth remain low (Physical Activity Guidelines for Americans Midcourse Report, 2012). That is why the PAGA Midcourse Report stated the following as their key finding and recommendation: “School settings hold a realistic and evidence-based opportunity to increase physical activity among youth and should be a key part of a National strategy to increase physical activity”. The studies described below validate that message. Several CBPA intervention studies have demonstrated that CBPAs elicit significant increases in PA (Ahamed et al., 2007; Bartholomew & Jowers, 2011; Donnelly et al., 2009; Goffreda, 2010; Kriemler et al., Jurg et al., 2006; Mahar et al., 2006; 2010; Reed et al., 2010; Stewart et al., 2004; Trost et al., 2008). While not statistically significant, other studies were able to quantify an increase in PA minutes compared to traditional classes (Naylor, Macdonald, Warburton, Reed, & McKay, 2008; Pangrazi, Beighle, Vehige, & Vack, 2003).

There are different ways to quantify PA that help to measure the reach of CBPA interventions in increasing PA. Pedometers or ‘step counts’ are a common method as they are cost efficient (Bartholomew & Jowers, 2011; Erwin, Beighle, Morgan, & Nland, 2011; Mahar et al., 2006; Naylor et al., 2008; Pangrazi et al., 2003; Reed et al., 2010). Others, especially in more recent studies, use accelerometers which is a more informative measure of energy expenditure (Donnelly et al., 2009; Goffreda, 2010; Kriemler et al., 2010; Lanningham-Foster et al., 2009; Trost et al., 2008;). However, PA equipment is

not required to quantify PA. Teachers can fill out a daily activity log (Ahamed et al., 2007) or participants can complete an activity questionnaire (McKay et al., 2005).

Pangrazi et al. (2003) took one of the first looks at the effectiveness of a teacher-lead school PA intervention by analyzing the program called P.L.A.Y. (Promoting Lifestyle Activity in Youth). P.L.A.Y. was implemented by the Arizona Department of Health Services to promote higher levels of PA for fourth-sixth graders. Pedometer steps counts and BMI information was gathered for 606 fourth grade participants over the spring-term. Results indicated the treatment was effective at increasing the PA level of children, especially girls. Boys did not show as much of an improvement which was attributed to a potential ceiling effect. Girls at that age tend to be less active than boys, so programs to increase activity levels in schools may provide greater benefit to them (Pangrazi et al., 2003). Naylor et al. (2008), on the other hand, found the opposite gender trend. There were no differences between the CBPA group (Action Schools! BC) and the control group for girls, while boys took almost 2,000 more steps under the interventions. Therefore, generalizations between genders cannot be made at this time.

Stewart et al. (2004) quickly followed with a five-day intervention involving three classes using Take 10!. Five students from first, third, and fifth grade wore an accelerometer during the 8-9 CBPA's they did during that week. By using accelerometers with several activities, Stewart and colleagues were able to show huge variation in energy intensity with different activities. Within the same grade some activities produced exercise intensities as much as 44% higher than others. Overall, students gained between

86-91 PA minutes that week, with similar metabolic equivalent values across grades, but pedometer steps and Kcal expenditure increased with grade level.

Looking at CBPA interventions for students younger than first grade, preschoolers completing eight weeks of Move and Learn integrated curriculum, exhibited significantly higher levels of classroom moderate-vigorous PA compared to controls (Trost et al., 2008). In a study of kindergarten-fifth graders, Bartholomew and Jowers (2011) found that all grades increased approximately 1000 steps with the same intervention. In another study that included Kindergarteners, intervention classes averaged approximately 780 more daily in-school steps than the control classes. Broken down by grade, the kindergarteners' average steps during Energizer activities were on par with first-fourth graders (Mahar et al., 2006). Incidentally, this study also noted substantial variation in step counts between activities with a range of 160 to 1223 steps for a single Energizer (Mahar et al., 2006).

Beyond PA measurements, some researchers have attempted to directly quantify CBPA effect on obesity through skin fold measurement and BMI (body mass index). Kriemeler et al. (2010) was able to show more negative changes in skinfold measurements in the PA intervention group, and an increase in aerobic fitness. The intervention was over the course of one school year and included daily activity breaks, adding two PE lessons (making PE daily), and PA homework. This is one of the more intensive PA interventions, which could raise questions of feasibility and adherence. However, teachers and children reported enjoying it, and thus must not have perceived it



as too demanding. To be certain, future studies of similar duration and intensity should assess children's affect and academic performance under these conditions.

Donnelly and colleagues (2009) have the longest intervention to date and, like Kriemeler et al. (2010), also attempted to directly measure the effect of CBPA on obesity by assessing BMI change. Their CBPA program called Physical Activity Across the Curriculum (PAAC), promotes 90 minutes per week of moderate to vigorous physically active academic lessons. While the results did not show a statistically significant decrease in BMI, they were able to demonstrate that BMI was significantly influenced by exposure to PAAC. PAAC schools that did greater than 75 minutes per week of PA had a significantly less increase in BMI at three years than the control group. A subsample of students wore accelerometers, which showed significantly higher levels of PA compared to control schools. All PAAC students also had significant changes in academic achievement scores which will be discussed in the following section.

A CBPA study done in China resulted in a significant change in BMI between girls allocated to the Happy 10 intervention group and those in the control group (Liu et al., 2008). Girls in the intervention arm had a significant decrease in BMI while the control arm girls significantly increased resulting in a significant change between groups post intervention. The program implemented at least one activity a day for two semesters. While these results are encouraging for CBPA, because diet was not controlled for, and control classes had an unexplained drop in energy expenditure over the course of the intervention, future research needs to validate these results.

Shifting from obesity to osteoporosis prevention, McKay et al. (2004) wanted to see if an 8-month “Bounce at the Bell” program would improve proximal femur bone mass. Teachers instructed students to perform 10 counter-movement jumps at the morning, noon, and home time bell. Total intervention time was three minutes per day. Results indicated this novel and easy exercise program provided significant gain in bone mineral content in two regions of the femur.

Macdonald (2007) with the help of colleagues including McKay, expanded on McKay et al. (2004) by doubling the length of the “Bounce at the Bell” intervention to 16-months, adding 15 minutes/day of CBPA (skipping, hopping, resistance bands), and increasing the sample size  $n = 410$  (from  $n = 122$ ). The researchers were again searching for evidence that early physical activity interventions may prevent osteoporosis and related fractures later in life (Kannus et al., 1999). The intervention enhanced bone strength at the distal tibia in prepubertal boys (Macdonald et al., 2007). These results demonstrate that simple, quick weight-bearing activities enhance bone strength for some children. Future research needs to determine the precise exercise prescription needed to elicit a similar response in more mature boys and in girls.

Although most school-based interventions thus far have not been able to demonstrate significant improvement in BMI, they do elicit an overall health benefit (Harris, Kuramoto, Schulzer, & Retallack, 2009). CBPA increases PA minutes and energy expenditure, can improve bone strength, and serves to break up extended sedentary time. The Active Living Research (ALR) brief (2013), also noted that based on the evidence that CBPA can impact overall daily PA, CBPA may be encouraging

students to be active on their own outside of class. In addition, CBPA is helping to reduce the potential danger of extended sedentary behavior at school, which in turn, may reduce chronic disease risk (ALR, 2013).

Health benefits from CBPA are only part of the picture. The next section describes how the benefits of CBPA go beyond the body and supports the brain's cognition, learning, and affect.

### **Learning Benefits from CBPA**

Regardless of whether a teacher, school administrator, parent, or legislator is a proponent of increased PA for kids or increased academic potential, youth can get the benefit of both with CBPA. The amount of benefit will vary with each child, but to date there has not been single intervention study published showing a negative effect of CBPA on academic performance or PA for that matter. This section outlines the potential of CBPA to improve students' concentration, on-task behavior, and ultimately test scores.

One key predictor of academic success is academic engagement: the ability to pay attention in class and to make an effort to learn (Greenwood, Horton, & Utley, 2002). Three CBPA interventions attempted to improve students' concentration, one aspect of engagement. The first intervention incorporated only five minutes of moderate to vigorous activity (e.g. running) four times a week. The second grade teacher reported she was able to complete more class activities because the students' concentration improved (Maeda & Randall, 2003). In addition, the math fluency for the 19 students increased and their overall grades were not negatively affected by the time used to run. Two important distinctions in this study are that PA was facilitated outside rather than in the classroom

and results were based on self-report from a single teacher. Norlander et al. (2005) also found improved concentration as well as a reduction in noise but with a different intervention style. In place of moderate to vigorous activity, a relaxation program was used in the classroom for 5-10 minutes consisting of a series of stretches for the upper body. Using sound monitors in intervention and control classrooms, researcher found a significant reduction in noise level. The relaxation program and noise reduction did not result in a significant reduction on students' self-reported stress levels as predicted, but teachers reported an increase in their pupils' ability to concentrate. *The Class Moves!* program also utilizes relaxation exercises to promote a better atmosphere for kids and improve their concentration (Lowden et al., 2011). When evaluating the program, most teachers claimed the impact on pupil concentration was evident and some reported marked improvements. Some used the program to wake kids back up after a long work session while others used it to calm a restless class (Lowden et al., 2011).

Another way to assess academic engagement is to have researchers observe the total time students' spend focused on academic tasks (Bartholomew & Jowers 2011). Mahar and colleagues (2006) measured students' on-task behavior before and after 10-minute, integrated activities called Energizers. When compared to a control group who took a 10-minute break, the Energizer group showed a significant positive result for on-task behavior, pre- to post-activity. The mean difference observed was large ( $ES = 2.20$ ) (Mahar et al., 2006).

Grieco et al. (2009) also evaluated students' time-on-task after 10-15 minutes of activity with *Texas I-CAN!*. Based on their observations of both active and inactive third

grade classes, they concluded physically active classroom lessons provided a buffer to prevent the steep reduction in time-on-task experienced after a period of inactivity in all children. Grieco et al. (2009) also gathered BMI data and found that trend to be especially prevalent for the overweight students.

As mentioned earlier and as observed by Grieco and colleagues (2009) with differences among BMI categories, the benefits of CBPA is not consistent for everyone. In addition to body type, learning styles will also change their impact. Della Valle and colleagues (1986) found that taking active-preferred seventh graders around the perimeter of the classroom to collect cards enhanced their performance on a word recognition task. Passive learners, however, had poorer performance in an active environment. Thus, the researchers suggested that to maximize performance for all children, teachers are encouraged to match environment to learning style (Della Valle et al., 1986). When that is not feasible, teachers do what is best for the majority of students. According to Hannaford (1995), 85% of children are kinesthetic learners and therefore learn better by moving and interacting with their environment. That suggests a large proportion of children in school would benefit from CBPA.

The aforementioned studies sought to predict academic performance while others directly measured that outcome variable. A quick way to do that is a timed-test or a short memory retention activity. Maeda et al. (2003) used a one-minute addition test with second grade subjects to assess math fluency after a five-minute walking or running break. In an unpublished work, Vazou and colleagues used a multiplication math fluency test with fourth graders. The test was used to detect math fluency differences between

students who practiced math with physical activity and those that practiced using worksheets or stationary math activities. Both groups improved pre to post with the PA group having a higher, yet insignificant mean gain.

Another common cognitive test is the Standard Progressive Matrices (SPM) fluid intelligence test. Since fluid intelligence measures the ability to reason quickly and abstractly it is not heavily dependent on previously learned knowledge (Reed et al., 2010). In a study by Reed et al. (2010), third graders fluid intelligence was positively influenced by physical activity. The intervention incorporated 30 minutes of PA integrated into the core curriculum three times a week. All activities were performed in the classroom with no equipment. Hill et al. (2010) used a different cognitive test than Reed et al. (2010) and also showed physical exercise to positively impact cognitive performance.

Not all studies found significant improvement in learning outcomes with CBPA. Molloy (1989) and Uhrich & Swalm (2007) both reported non-significant effects with some of their PA and academic performance outcomes. Ahamed et al. (2007) increased PA by 47 minutes per week yet academic performance remained the same, showing no effect. However, no effect remains an encouraging result because despite a reduction in instruction time, students' academic achievement was not compromised. Only a negative effect, which there is none to date, would raise caution about the use of CBPA.

While no effect is acceptable, academic performance gain associated with CBPA makes an even stronger case for implementation. Fredericks, Kokot, & Krog (2006) and Donnelly et al. (2009) were both able to show academic improvement in multiple subject

areas under a single intervention. Fredericks et al. (2006) randomly selected first graders to be in the experimental, control, free-play, or educational toys group. The experimental group, which involved 20-minutes of developmental movements and structured exercise, showed a significant improvement in spatial development as well as in reading and mathematical skills. The PAAC intervention, described earlier had an exceptionally strong intervention effect due to its large sample size and long duration (Donnelly et al., 2009). From baseline to three years, significant improvement in academic achievement was observed in the PAAC compared to the control school for reading, math, and spelling.

While there is more to learn, a few key mechanisms have been suggested that may explain the effect PA has on brain function. In general, it is thought that PA invigorates the body, activates the brain, and provides better blood flow. With greater blood flow epinephrine and norepinephrine are more readily available helping children be more alert and ready to learn (Hannaford, 1995; Jenson, 2000). More specifically, regular physical activity can promote structural changes in the region of the brain important for memory (Cotman & Engesser-Cesar, 2002). Hillman, Buck, Temanson, Pontifex, and Castelli (2009) found that fitness, which can be improved with regular PA, was correlated with stronger attentional resources during a stimulus, resulting in faster decision making.

The evidence is clear that exercise can increase brain-derived neurotrophic factor (BDNF), which enhances learning and cognition. BDNF enhances brain function through neurogenesis, the creation of new neurons (Cotman & Engesser-Cesar, 2002). In mice studies, the increased neurogenesis from running enhanced their memory function

in a water maze (van Praag, Christi, Sejnowski, & Gage, 1999). BDNF has also been found to increase essential structural elements located throughout the central and peripheral nervous systems (Hannafor, 1995).

Based on available evidence we can conclude that sacrificing physical education or recess for classroom time does not improve academic performance (Reed et al., 2010). The research evidence also provides the necessary evidence to show policy makers that reducing academic teaching time to allow for PA will not come at a cost to learning. On the contrary, results from numerous studies indicate that cutting opportunities for PA undermines the ability for children to maximize their learning capacity (Della Valle et al., 1986; Donnelly et al., 2009; Hill et al., 2010; Maeda et al., 2003; Mahar et al., 2006; Norlander et al., 2005; Reed et al., 2010).

Thus far, we have discussed CBPA's direct effect on PA levels and academic achievement; however it is also important to look at factors that may mediate or moderate the role of CBPA in PA and academics. One possible factor is students' motivation but research on this is in its infancy. The following section will provide some background on Self-Determination Theory, its importance in predicting human behavior, and the rationale for assessing its role in CBPA use.

### **Academic Motivation**

It is well understood that individual's perceptions about their competence and intrinsic motivation are particularly important for a student's academic achievement, what is less explored is the role of CBPA on motivation. Intrinsically motivated behaviors positively relate to several important facets of success in school: persistence,



effort, psychological well-being, and achievement (Burton et al., 2006; Deci & Ryan, 1987; Gottfried, 1985; Linnenbrink & Pintrich, 2002). Self-Determination Theory (SDT) is a prominent theory in the study of intrinsic motivation. According to SDT, intrinsic motivation refers to doing something because it is inherently interesting or enjoyable. It is in contrast to extrinsic motivation which is doing something because of external pressures and rewards (Ryan & Deci, 2000).

The maintenance and enhancement of intrinsic motivation is theorized to be regulated by an individuals' basic psychological needs: competence, autonomy, and relatedness. The first two needs were first presented by Deci and Ryan (1985) as a subtheory within SDT called cognitive evaluation theory. Competence refers to feeling effective in one's ongoing interactions with the social environment and possessing the necessary skills to be successful. In education, positive relations between intrinsic motivation and perceived competence are often found. For example, four German elementary school were examined over a two-year period and found children's competence beliefs were moderately to strongly associated with their learning motivation (Spinath & Spinath, 2005).

While competence or self-efficacy is important in and of itself, the theory states it will not enhance intrinsic motivation unless accompanied by a sense of autonomy. Choice, acknowledgement of feelings, and opportunities for self-direction were found to enhance intrinsic motivation because they allow people an enhanced feeling of autonomy (Deci & Ryan, 1985). Researchers have examined teachers who are autonomy supportive, in contrast to controlling, and found their students had greater intrinsic

motivation, curiosity, and desire for challenge (Deci, Nezlek, & Sheinman, 1981; Flink, Boggiano, & Barrett, 1990). Based on past research, three methods arise as the best strategies for teachers to be autonomy-supportive. One method is to provide students with choice as to what they feel is interesting or important. A second is to foster relevance by identifying the value of tasks, lessons, or behavior. The third part of being an autonomy-supportive teacher is showing respect, allowing criticism, and avoiding pressuring students (Assor, Kaplan, & Roth, 2002; Reeve, Jang, Carrell, Jeon, & Barch, 2004).

People with high needs satisfaction in competence and autonomy can be intrinsically motivated for a behavior, however with the addition of the final fundamental need, relatedness, a greater expression of motivation can emerge (Deci & Ryan, 2000). Relatedness refers to feeling connected to others, to caring for and being cared for by those others, and having a sense of belongingness (Ryan, 1995). In school this can include feeling involved with your classmates or cared for even when working alone.

Classroom strategies that enhance competence, autonomy, and relatedness can foster stronger intrinsic motivation at various levels. Vallerand et al. (1997, 2001, 2002) with both theory and empirical research findings has suggested a hierarchical model for motivation at global, contextual, and situational levels. Global motivation reflects how an individual generally interacts with the environment. It is the highest level and thus considered stable. Contextual motivation refers to the particular motivation an individual has for a specific life context, such as work, school, or PA participation. At the bottom of the hierarchy is situational motivation, which is unstable due to its sensitivity to the

environment (Vallerand, 2001). Research on CBPA needs to target both situational and contextual motivation and the interplay between the two. Altering student's classroom experiences at the situational level could over time have an impact on their motivation towards their school subjects at the contextual level. It is also important for interventions designed to increase intrinsic motivation at the situational and contextual levels be done at the elementary age as previous studies show a decline in intrinsic motivation with age (Spinath & Spinath, 2005). Furthermore, children's motivation is more malleable between the ages of nine and 11 years (Cox, Smith, & Williams, 2008).

Several studies have shown basic needs satisfaction to be predictive of motivation (e.g. Ntoumanis, 2001, Reeve et al., 2004) and motivation to be predictive of behavior and academic performance (e.g Jang, Kim, & Reeve, 2012; Ntoumanis, 2005; Roemmich, Lambiase, McCarthy, Feda, & Kozlowski, 2012; Standage, Sebire, & Loney, 2008; Teixeira, Carraca, Markland, Silva, & Ryan, 2012), but only one study to date has performed this type of study in regards to physical activity in the classroom (Vazou et al., 2012). Using a within-subject sample of 236 fourth to sixth grade students in urban and rural regions of Greece, Vazou and colleagues used the Intrinsic Motivation Inventory to assess students' task-specific subjective experiences in response to active and traditional academic lessons. The first two lessons were taught in the traditional format and served as baseline controls. Ten-minutes of PA were incorporated into lessons three and five. The CBPA's were developed based on the tenets of SDT, that is, without emphasizing inter-individual comparison, being fun, easy-to-accomplish and providing choices. The remaining lessons, four and six, served as additional controls. Results demonstrated that

integrating PAs with academic subjects can significantly increase children's intrinsic motivation, perceived competence, and effort, without enhancing perceptions of pressure and negatively affecting the value of the lesson, compared to traditional lessons.

Children self-reported the lessons that integrated PA were more interesting and enjoyable than the lessons that did not (Vazou et al., 2012). While more research needs to be done regarding the role of CBPA on motivation, this initial investigation provides encouraging results.

## CHAPTER 3

### METHODS

#### Participants and Setting

The study was conducted in central Iowa with fourth and fifth grade students in the fall term of 2012 (Oct-Dec). Data were obtained from four schools from three different settings a) two rural consolidated elementary schools, b) one rural consolidated middle school, and c) a Catholic parochial school in a university community. All the schools were in a 20-mile radius from one another. The schools serve primarily European American students (>85%) and all of the teachers were European American females. The average class size was 22 students with a range of 15-26. Age was not measured, but typical fourth and fifth graders are nine-11 years old.

Seven fourth grade teachers agreed to be in the intervention (named Move for Thought-M4T from here on) group. Five of those teachers taught math using M4T to eight classes ( $N = 185$ ; 89 females). The remaining two teachers used M4T in language arts with five classes who were also using M4T in math. Those students also took language art specific surveys and academic tests, but those data do not constitute part of the current project and will be discussed separately.

The control group was comprised of seven fifth grade classes ( $N = 127$ ; 58 females). Ninety-six of these students were from a middle school while 31 attended a parochial elementary school. Informed consent was obtained from these teachers and

they were asked to conduct class as normal. A summary of participant information is provided in the appendix.

## **Measures**

### **Demographics**

Student's code number (no names were provided), gender, grade, and ethnic background were reported. Teacher's name, gender, the grade and the subject (s)he was teaching and the name of the school were also provided. Parental consent was waived, as students were de-identified.

### **Teacher log**

Teachers were asked to keep track of the frequency and duration of the Move for Thought activities they were using for the eight weeks of the implementation period, and report them in a log that was developed for that purpose. On a daily basis, teachers were asked whether they used any Move for Thought activities (yes-no response), the number of the activity from the package (one-ten), and the duration of the activity (with a five-point response scale, incrementing from five to twenty-five minutes). The teacher log template is provided in the appendix. The other items included in the teacher log will be analyzed in a later study.

### **Math Performance (MP)**

Comprehensive grade-level appropriate math tests were used in this study to quantify academic performance improvement. Standardized tests were found through Curriculum-Based Measurement, *easyCBM* Light Edition ([www.easycbm.com](http://www.easycbm.com)). The mathematics tests through CBM are currently based on the National Council of Teachers

of Mathematics (NCTM) Curriculum Focal Point Standards in Mathematics. Therefore, tests were not generated based on current class content, but instead on overall grade level expected content. There are different test types per grade (aligned with the NCTM Curriculum Focal Points for each grade level). Each of the math tests were comprised of 16 items. The math operations and algebra test was chosen for our study. One test from each grade can be found in the appendix. All alternate forms of each math test were designed to be of equivalent difficulty, so that teachers can monitor students' progress (Alonzo & Tindal, 2012). One math test was used as a pre-test and another math test as a post-test. Data collected from the tests were entered as a one (correct) or zero (incorrect/no entry).

### **Basic Need Satisfaction from Math**

General motivation for math between the M4T and tradition lesson group was measured, with the satisfaction of the three basic psychological needs, named Competence, Autonomy and Relatedness. The Perceived Competence for math factor was assessed with the modified version of the Intrinsic Motivation Inventory (IMI; McAuley, Duncan, & Tammen, 1989) that has been previously used with this age group by Dr. Vazou. Relatedness was measured with the Activity Feeling Scale (Reeve, 1994), and Autonomy with three out of the nine items from the Perceived Self-determination Scale (Reeve, 2003), that measures an overall score for autonomy based on three factors, named perceived locus of causality, volition and perceived choice. In order to keep the survey short and avoid fatiguing the students as well as taking additional time from their instruction, only three out of the nine items (one from each factor) was selected (based on

the language that was most appropriate for that age group). Item examples are “I find most things are easy to learn and do in math” (competence), “I feel I have some choice over which activities to try to solve in math” (autonomy), and “I feel involved with my classmates when doing activities in math” (relatedness). The response scale ranged from 1 (strongly disagree) to 5 (strongly agree). A complete list of the items and factors can be found in Appendix A.

### **Basic Need Satisfaction from Integrated Physical Activity (IntPA) with Math**

At the end of the eight weeks the M4T group completed an additional motivation survey pertaining specifically to the M4T activities they did in math. The Activity Feeling Scale (Reeve, 1994) was used, which measures situational need satisfaction and includes three factors, named competence, autonomy and relatedness. Students responded to the stem: “Doing the PA in the classroom made me feel...”. Item examples included “Doing the physical activities in the classroom made me feel that my skills were improving” (competence), “Doing the activities in the classroom made me feel free to decide for myself what to do” (autonomy), and “Doing the activities in the classroom made me feel involved with my classmates” (relatedness). A five-point response scale was used, ranging from one (strongly disagree) to five (strongly agree). A complete list of the items and factors can be found in Appendix A.

### **Procedure**

The study involved a quasi-experimental design. Five teachers agreed to implement the Move For Thought activities with math and five teachers agreed to serve as a control group, meaning that they used the standard curriculum and no changes were



made in the regular teaching strategies. Both intervention and control classes completed surveys before and after eight weeks. Motivational math surveys and timed math tests were completed before and after the eight weeks of the intervention period in the students' classroom for both groups. The IntPA motivational survey was completed at the end of the intervention period only by the M4T group because it measures students' experiences from the specific teaching method.

Teacher and principal contacts were made by the primary researcher through email correspondence followed by an in-person explanation of project. Both intervention and control teachers signed an informed consent before any research was conducted in their classroom. The study was approved by the Institutional Review Board at Iowa State University.

Students in both groups were assigned a code number by their teacher. The codes were kept by the teacher and used by the students for any documents completed for research. All tests and surveys were collected by the researcher upon completion and kept locked in a file cabinet at the Institution's area. Student responses were therefore confidential from both the classroom teacher as well as the researcher, and thus, informed consents were not required. Self-reported gender, grade, and ethnic background were collected from all participants as part of the math survey.

Both groups completed identical math motivational surveys before and after the end of the implementation period and had the survey read aloud by the researcher. Students were instructed to answer in their own opinion, there were no 'right' or 'wrong'

answers, and were reminded that all the questionnaires would remain confidential from both the researcher as well as their teacher.

Academic performance tests were given to all students at baseline and at the end of the implementation period. Different, yet equivalent tests were given at the two time points to reduce a carry-over effect. All 16-item multiple-choice tests were timed so the speed of comprehension was accounted for. Fourth grade classes were allotted 3 minutes and the fifth grade classes two minutes and 30 seconds to answer as many questions as they could. Less time was given to the fifth grade students to reduce a ceiling effect at baseline and ensure improvement potential. A single researcher proctored the tests at both time points for both groups. Students were instructed how much time they would be given, the general types of questions they would see, they could but were not required to show their work, that questions could be skipped, and they needed to circle an answer in order for it to be counted.

M4T Students completed the IntPA survey at the end of the implementation period without teacher or researcher assistance and were reminded their responses would remain confidential.

### **Move for Thought**

Move for Thought (M4T) is a physical activity (PA) promoter program that integrated the content of the academic subject with physical activity in the elementary classroom. M4T was developed by Spyridoula Vazou, Ph.D. (Department of Kinesiology, Iowa State University) in 2012. The creation of the program was based upon the growing evidence of the benefits of incorporating PA in the elementary

classroom. The M4T kit includes ten activities that can be adapted for all elementary grades in any subject area. All of the activities are intended to target aerobic fitness, be easy and safe to implement, and promote intrinsic motivation for both learning and PA. For example, ‘Find you Pair’ is one activity in the kit. Here the students do an assigned move (e.g. skipping) until the teacher gives a signal for them to find a randomly placed card in the room. Without talking, students need to find a matching card while doing an assigned move (e.g. lunges). One card might be a definition to be paired with its term or one card is a problem needing its answer. When a pairing is made, students do a movement (e.g. calf raises) until the teacher checks the paired cards. All the activities can be repeated once the flash cards are made, as students will have new cards to pair each time. A second activity is ‘Curious Ball’ where a student catches a ball and answers the question that corresponds to their left thumb’s placement on the ball and then passes the ball to the next student. All students can be performing a PA (e.g. hopping) while waiting to catch the ball.

In addition to the activity descriptions, the kit includes the research basis for classroom PA, teaching tips, examples of how to move, and an outline of how to navigate the activity cards. M4T is available free online through the Iowa Department of Education website ([www.moveforthought.org](http://www.moveforthought.org)) and is also included in the appendix of this thesis.

### **Intervention**

Participating teachers were given the M4T kit to learn and subsequently implement in math during the eight-week intervention. Teachers were encouraged but

not required to use M4T daily for an average of ten minutes. Each teacher filled out a daily teacher log provided by the researcher to document the activity frequency and duration, activity choice, the time of day, any variations, and reactions. Teachers were invited to ask the research team at any time for clarifications or ideas on how to use the package. For the students, completion of the surveys and tests was voluntary but participation in the activities during the implementation period was part of their learning and, thus, all students participated.

### **Data Analysis**

Data were analyzed using the Statistical Package for Social Sciences 19 (IBM SPSS Statistics). Internal reliability for the motivation surveys was tested with the Cronbach's alpha coefficient. All factors with an alpha greater than 0.60 were retained (especially when there were only three items). Pearson correlation was assessed for math and IntPA perceived competence, perceived autonomy, perceived relatedness, pre MP, and post MP. The primary goal of the study was to evaluate changes in math performance and motivation from M4T compared to traditional practice. Repeated Measures ANOVA was used to check for a within-subjects Time (pre and post) and between-subjects Group (M4T and traditional) interaction. A secondary goal was to evaluate student's reactions to the M4T activities by looking at their needs satisfaction on the IntPA survey. The data are reported as mean values (SDs) unless otherwise stated. The level of statistical significance was set at  $p < 0.05$ .

Lastly, hierarchical regression analyses were used to see the role of the intervention and the student's needs satisfaction with integrated physical activity in predicting academic performance, when controlling for gender and pre MP.

## CHAPTER 4

### RESULTS

#### Intervention Fidelity

Seven out of the eight M4T classes completed the eight-week intervention ( $N = 157$ , males = 83, females = 74). After three weeks, one school dropped out of the study. In an interview the teacher explained her math section was split into two parts by physical education so further activity time was not warranted. All seven traditional classes were retained ( $N = 127$ , males = 69, females = 58). The M4T and traditional classes all completed identical math motivation surveys. The optional math performance tests was given to five out of seven of the M4T classes (2 teachers opted out), which all seven control classes did the math performance task. Specific details on participants can be found in Table 1.

Teacher logs were collected from the four M4T teachers. Teachers recorded frequency and duration daily eight weeks of the implementation period. On average, the teachers incorporated M4T with math 50% ( $\pm 10\%$ ) of the time school was in session. Overall daily frequency ranged from 35% to 65% among the seven classes. The average duration of a single activity was 10 minutes ( $\pm 1.5$ ) with an overall addition of 15 to 30 minutes per week, similar to adding one physical education class. Total time spent on M4T lessons over the eight weeks ranged from 125-250 minutes with an average of 185 ( $\pm 58$ ) minutes.

Table 1.

Sample Characteristics, Iowa, 2012

<b>Characteristic</b>	<b>Move for Thought (M4T) <i>N</i> = 157</b>	<b>Traditional  <i>N</i> = 127</b>
<b>Sex, n (%)</b>		
Boys	83 (53%)	69 (54%)
Girls	74 (47%)	58 (46%)
<b>Grade level, n (%)</b>		
Fourth	157	--
Fifth	--	127
<b>Schools</b>	2	2
<b>Classes</b>	7	7
<b>Teachers</b>	4	4
<b>European American</b>	135 (86%)	104 (82%)

### Reliability Analysis

A reliability analysis using Cronbach's alpha coefficient was done on the three basic needs for both the Math Motivation factors as well as the Integrated Physical Activity (IntPA) factors to determine the internally consistent items that comprise each factor, in order to be used in statistical analysis. The reliabilities for all the motivational variables, except for Perceived Math Autonomy, were acceptable. Math Autonomy comprised three items, but inter-item correlations were very low and thus, the items were not grouped together in order to represent the Math Autonomy factor. It is possible that because the original scale was developed for adults, the content of the items was confusing for this age group. After communication with the scale developer, it was evident that younger children have difficulties in understanding the locus of causality and

volition, whereas, perceived choice seem to be an easier concept to understand. Several researchers have used only perceptions of choice in order to measure satisfaction of the need for autonomy with children, and for that reason, in the current thesis, analyses were conducted using only the item that measures choices in math. Thus, from this point forward, any reference to Perceived Math Autonomy equals perceptions of choice. Nevertheless, results pertaining to Math Autonomy should be carefully interpreted and necessitate further exploration. Alpha reliabilities are presented with the variable means and standard deviations within their respective section in Table 2 below.

Table 2.

## M4T and Traditional Students' Perceptions of Three Basic Needs for Math

Variable		<i>Move For Thought</i>			<i>Traditional Classes</i>			Range	$\alpha$
		N	M	SD	N	M	SD		
Performance	Pre	107	52.28	19.11	118	49.84	15.73	% correct	--
	Post	107	66.35	18.12	118	54.02	18.12		
Competence	Pre	137	3.68	0.07	135	3.89	0.91	1-5	0.85
	Post	135	3.71	0.87	134	3.91	0.92		0.88
Autonomy	Pre	136	3.41	1.01	133	3.41	1.12	1-5	--
	Post	135	3.22	1.19	134	3.25	1.99		
Relatedness	Pre	136	3.63	0.76	135	3.43	0.86	1-5	0.68
	Post	135	3.39	0.98	134	3.18	0.98		0.77

## Descriptive Statistics

On average, both M4T and tradition classes, correctly answered half of the math questions in the allotted time ( $Mean_{M4T} = 52.28$ ,  $Mean_{traditional} = 49.39$ ). Both groups improved at follow-up ( $Mean_{M4T} = 66.35$ ,  $Mean_{traditional} = 54.02$ ), but with the intervention



group averaging a 10% higher score, which can translate into an academic letter-grade (Table 2).

Students in the M4T and traditional classes had similar responses both pre and post on the math motivation survey. On the five-point Likert Scale, with one being ‘strongly disagree’ and five being ‘strongly agree’, students’ on average responded between 3.18-3.91 for Perceived Math Competence, Autonomy, and Relatedness, meaning being closer to the “agree” response option. Perceived Math Competence had a consistently higher student response average than Perceived Math Autonomy and Relatedness with no significant changes after the intervention (Table 2).

Students that implemented the M4T kit also rated their perceived needs satisfaction toward the IntPAs (on a five-point scale) at the end of the intervention (Table 3). The students’ responses for IntPA Competence, Autonomy, and Relatedness reflected high needs satisfaction ( $Mean_{IntPA\_Competence} = 4.15$ ,  $Mean_{Math\_Competence} = 3.71$ ;  $Mean_{IntPA\_Autonomy} = 3.66$ ,  $Mean_{Math\_Autonomy} = 3.22$ ;  $Mean_{IntPA\_Relatedness} = 3.90$ ,  $Mean_{Math\_Relatedness} = 3.39$ ).

Table 3.

M4T Perceptions of Three Basic Needs for the Integrated Physical Activities.

<b>Variable</b>		<b>N</b>	<b>M</b>	<b>SD</b>	<b>Range</b>	<b><math>\alpha</math></b>
<i>Integrated PA</i>						
Competence	Post	122	4.15	0.73	1-5	0.75
Autonomy	Post	122	3.66	0.92	1-5	0.69
Relatedness	Post	122	3.90	0.99	1-5	0.77

All of the motivational variables for both math and integrated activities had significant positive correlations. These correlations indicate that, even though the factors share some common variance, there is also variance that is unique to each factor.

Perceived Math Competence pre and post and Perceived IntPA Competence were the only three variables that significantly correlated with the math pre test scores, the rest did not. Post math scores also correlated with Perceived IntPA Relatedness and to a lesser degree Perceived IntPA Autonomy, in addition to the others. Table 4 shows the results of the correlations among all variables.

Table 4.

Correlations among Math and Integrated Physical Activities Basic Need Satisfaction and Math Performance

	2	3	4	5	6	7	8	9	10	11
1 Math Competence Pre	0.28**	0.36**	0.74**	0.28**	0.24**	0.32**	0.23**	0.27**	0.39**	0.36**
N	284	286	275	275	275	179	179	179	246	237
2 Math Autonomy Pre		0.39**	0.24**	0.38**	0.27**	0.26**	0.21**	0.20**	-0.05	0.030
N		283	272	272	272	179	179	179	243	234
3 Math Relatedness Pre			0.23**	0.34**	0.59**	0.33**	0.59**	0.34**	0.06	0.030
N			274	274	274	179	179	179	245	236
4 Math Competence Post				0.28**	0.27**	0.45**	0.30**	0.32**	0.37**	0.36**
N				284	284	180	180	180	241	246
5 Math Autonomy Post					0.36**	0.18*	0.23**	0.29**	0.10	0.01
N					284	180	180	180	241	246
6 Math Relatedness Post						0.27**	0.59**	0.25**	0.10	0.05
N						180	180	180	241	246
7 IntPA Competence							0.68**	0.52**	0.20**	0.32**
N							188	188	162	158
8 IntPA Autonomy								0.52**	0.11	0.20*
N								188	162	158
9 IntPA Relatedness									0.14	0.23**
N									162	158
10 Pre Math Performance										0.48**
N										240
11 Post Math Performance										
N										

\*  $p < .05$ , \*\*  $p < .01$ , \*\*\*  $p < .001$

## Changes in Outcome Measures

### Baseline Differences Between the Classes

Baseline math performance between the two groups was compared using t-tests because of the nature of the design. The simple comparisons showed that the M4T and traditional classes did not differ significantly ( $t_{(1,239)} = 1.25$ ,  $Mean_{M4T} = 52.28$ ,  $Mean_{traditional} = 49.39$ ,  $p = 0.211$ ) at the baseline measures. The lack of preexisting differences suggests that the two groups did not differ in math performance before the intervention.

### Academic/Math Performance

A repeated measures analysis of covariance (ANCOVA), with Group (intervention and control) as a between subjects variable, Time (pre-post intervention measures) as a within variable and percent of correct answers on the timed-math test at the pre-test as the covariate, was conducted to determine if the students improved during the eight-week implementation period and if the improvement differed between the M4T and traditional classes. Results indicated a significant main effect on Time ( $F_{(9356,1)} = 59.67$ ,  $p = 0.000$ ,  $\eta^2 = 0.21$ ), Group ( $F_{(3059,1)} = 13.64$ ,  $p = 0.000$ ,  $\eta^2 = 0.06$ ), as well as a significant Time x Group interaction ( $F_{(2745,1)} = 17.51$ ,  $p = 0.000$ ,  $\eta^2 = 0.07$ ). Full results are presented below (Table 5). The time main effect means that both groups improved in math after eight weeks. The group main effect shows that the intervention group overall scored higher than the control group in math. The importance of the results lie in the significant Time x Group interaction, meaning that the classes that integrated the PA with the math practice in their lessons improved significantly more compared to the traditional

math practice lessons. The interaction is presented in Figure 2 (below). The mean and standard deviation results are presented in Table 2 with the motivational variables.

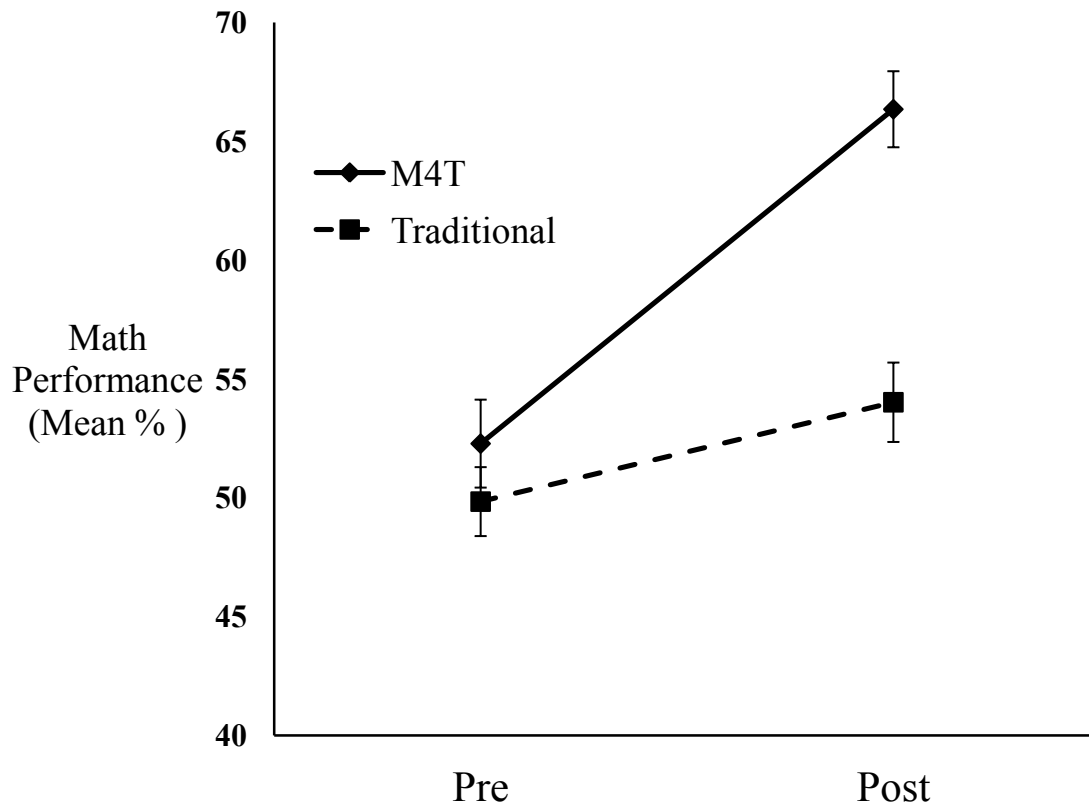


Figure 2. Mean percentage math performance score and standard errors for M4T classes and traditional classes over time.

Table 5.

Mixed Model Analysis of Covariance (ANOVA) for Math Performance as a Function of Time and Group

Variable	SS	df	MS	F	$\eta^2$	<i>p</i>
Time (Pre/Post)	9356	1	9356.70	59.67	0.21	0.000
Group (M4T/Trad)	3059	1	3059.06	13.64	0.06	0.000
Time x Group	2745	1	2745.93	17.51	0.07	0.000
Error	34967	223	156.80			

Time (Pre and Post the eight-week intervention), Group (Move for Thought, Traditional), SS = Sum of Squares, df = degrees of freedom, MS = Mean Square.

### Math Basic Need Satisfaction

In order to examine the effectiveness of the two types of math instruction in altering the students' satisfaction of the three basic needs and detect gender differences, repeated measure ANOVAs were conducted for each motivation variable (Perceived Competence, Perceived Autonomy, Perceived Relatedness). There were no significant gender differences, main effects, or interactions found between Time and Group (Competence ( $F = 0.04$ ,  $p = 0.83$ ), Relatedness ( $F = 0.57$ ,  $p = 0.45$ ), Autonomy ( $F = 0.00$ ,  $p = 0.99$ ). That means students' basic need satisfaction did not change over the eight weeks, the two groups did not differ, and that the intervention did not elicit changes in their perceptions. The mean scores and standard deviation for these variables can be found in Table 2.

### Relationship of Motivational Variables to Math Achievement

Hierarchical regression analyses were used to determine whether students' perceived motivation toward math and perceived motivation for the integrated physical

activities (IntPA) in math predicted students' math performance after the implementation period. The mean scores and standard deviation for IntPA variables can be found in Table 3. In all regression analyses, gender was entered in Step 1 to control for its potential effect, as well as pre-intervention math performance (Step 2). The first hierarchical regression analysis with the overall sample was conducted in order to examine whether perceived Competence, Relatedness, and Autonomy for math in general, as they were measured before the intervention period, could predict math performance without the input of the intervention. Results showed that Math Competence positively and significantly predicted Math Performance ( $R^2_{adj} = 0.16, \beta = 0.42, p = 0.000$ ), meaning students who perceive themselves to be competent in math tended to perform better on the timed-test. Math Relatedness did not predict Math Performance, while Math Autonomy (1-item) showed a significant negative relationship ( $R^2_{adj} = 0.17, \beta = -0.15, p = 0.012$ ). Students with lower autonomy tended to score higher on the math test and those with higher autonomy scored lower.

To examine intervention effects, pre-test math performance along with gender was entered in Step 1, pre-test math basic needs were controlled for in Step 2, and student reported perceived needs satisfaction for IntPA was entered in Step 3. Results showed that perceived IntPA Competence significantly contributed to the prediction of post-test Math Performance above the contribution of pre-test math needs satisfaction ( $\beta = 0.22, p = 0.004$ ). This shows the unique contribution of M4T in predicting Math Performance beyond the students' prior competence toward math in general. For full results see Table 6.

Table 6.

Hierarchical regression analysis of Math Performance post-test score.

Step	Variables	<i>Stand. <math>\beta</math></i>	<i>t</i>	<i>R</i> <sup>2</sup>	<i>R</i> <sup>2</sup> change	<i>F</i> change
1	Gender	-0.002	-0.03	0.21	0.021	19.48***
	Math Performance Pre	0.39	4.76***			
2	Math Competence Pre	0.20	2.51*	0.24	0.04	2.26
	Math Relatedness Pre	-0.06	-0.68			
	Math Autonomy Pre (1-item)	0.02	0.21			
3	IntPA Competence	0.22	2.07*	0.30	0.06	3.69*
	IntPA Relatedness	0.14	1.38			
	IntPA Autonomy	-0.06	-0.57			

*Note:*  $N = 151$ ; gender: 0 = males, 1 = females; \* $P < 0.05$ , \*\*\* $P < 0.001$ , Stand = Standardized, IntPA = Integrated Physical Activity



## **CHAPTER 5**

### **DISCUSSION**

Classroom-based physical activity (CBPA) has been shown to successfully increase physical activity time for youth as well as improve their learning (e.g. Donnelly et al., 2009; Grieco et al., 2009; Mahar et al., 2006; Reed et al., 2010; Trost et al., 2008). This study was the first to examine a recently developed integrated physical activity kit called Move For Thought (M4T). To accomplish this, seven intervention classes and seven control classes from four schools performed a timed math test and a motivation survey before and after eight weeks. Results showed that, consistent with our hypotheses, there was a greater gain in math performance for the M4T classes than the traditional classes. In regards to academic motivation, perceived competence positively predicted math performance. Regression analyses revealed that perceived competence associated with the M4T activities provided a unique and positive contribution to math performance, however, there was no significant change in the students' perceptions of autonomy or relatedness.

This study focused on physical activities integrated with math concepts in particular and uniquely gave the teachers freedom in regards to the frequency and duration of the activity usage. Each teacher found the best fit for her particular class. Two of the teachers used M4T with a small groups of students (six-eight) as they rotated through their math stations, while most used the activities with the whole class simultaneously. In one class, a student teacher facilitated the majority of the activities.

The overall contribution of the intervention was an average of 15-30 minutes per week for a total of 185 ( $\pm$  58) minutes over the eight weeks. Hence, even without stringent intervention guidelines, teachers choose to use the activities 50% of the time school was in session. This is the first demonstration, to our knowledge, that classroom activity packages do not require rigid usage criteria, but rather can offer general guidelines and give teachers more autonomy and still foster adequate adherence and produce significant results. Even when CBPA is only adding two to three 10-minute activity breaks a week, it is helping children accumulate 60 minutes a day, break-up extended sedentary time, and may encourage students to be active on their own outside of class (ALR, 2013; Anderson, 1998; NASPE, 2004).

Consistent with other interventions, the use of M4T activities demonstrated that integrating physical activities in math can significantly improve academic performance compared to classes that do not. The published research in this area consistently shows either no change in academic performance with the incorporation of physical activity minutes (e.g. Ahamed et al., 2007; Molloy, 1989; Uhrich & Swalm 2007; Vazou, under review) or a positive change (e.g. Donnelly et al., 2009; Reed et al., 2010). To date, no published studies have found allocation of PA minutes during classroom time to have a negative effect on students' learning. With that being said, it is valuable to note which CBPA package styles provide positive benefits to academic performance and this initial analysis has shown that M4T can.

It is possible this study uniquely shows academic improvement may not be dependent on the specific content used with the activity but rather transfers to an overall

improvement in subject comprehension speed. In other words, fourth graders in the M4T group may have primarily practiced multiplication or division facts during the activities, but showed significant improvement on a comprehensive, grade-appropriate exam that had questions involving time-telling, subtracting decimals, and short story problems (see appendix for test examples). Research explains academic improvement from PA may be due to greater blood flow, modified arousal level, improved levels of neurotransmitters, and the creation of new neurons in the brain (Best, 2010; Cotman & Engesser-Cesar, 2002; Jenson, 2000; van Praag et al., 1999).

Results showed that the mean scores for the integrated physical activity motivation were high in all three basic need satisfaction. Students appear to feel competent, relate to their classmates, and perceive a sense of choice with this teaching approach. Therefore, it is apparent that integrated physical activity can be incorporated in the classroom to increase activity minutes and academic performance without negatively impacting the students' perceived motivation for the academic lesson. Based on Self-Determination theory, and empirical research findings, satisfaction of all three psychological needs relates to positive motivation outcomes. A review by Teixeira et al (2012), showed the literature consistently finds competence satisfaction and more intrinsic motives to positively predict exercise participation across a range of samples and settings.

The results of the regression analyses showed that students' perceived competence for IntPA significantly predicted their math performance at the end of the intervention. Therefore, above and beyond the effect of their perceived competence

toward math in general, students who feel confident during the physical activity are attaining higher math scores. The relationship between IntPA and academic motivation was examined by Vazou et al. (2012). Consistent to our research findings, when movement was integrated in the academic lesson (in any subject area) students reported higher perceptions of competence, compared to the traditional lessons. While this is the first study to examine basic need satisfaction from CBPA on math performance, research has been conducted in other areas, such as physical education. Students who felt competence because of prior successful experiences were more likely to find physical education class more enjoyable and want to participate in it further to develop their skills (Ntoumanis, 2001). As Self Determination theory and previous research findings suggest, supporting children's competence encourages higher levels of intrinsic motivation, which positively predicts achievement (Gottfried, 1985; Lepper, Corpus, & Sheena, 2005; Ryan & Deci, 2000;).

Results on math need satisfaction did not indicate a significant difference before and after the intervention. This result may be attributed to the relatively high overall mean scores at baseline. The mean scores were stable for both the M4T classes as well as the traditional, which may also reflect that eight weeks is not long enough to elicit a change in a student's motivation for a school subject. Motivation for a school subject, such as math, is considered to be relatively stable, and according to Self-Determination theory (Vallerand & Lalande, 2011), is less susceptible to change, especially after a short period of time. These results are consistent with results from Vazou et al. (2012) and Vallerand and Ratelle (2002). It is possible that by fourth grade, students' overall

opinion about math is well formed. To improve youth's feelings toward their school subjects, different teaching strategies such as integrated physical activities need to start earlier or be implemented for a longer duration.

It is well understood that a perfect study with flawless internal and external reliability does not exist, and therefore, the limitations in the current thesis are discussed below. A potential limitation to the study is the lack of randomization and the use of fifth graders for the traditional classes and fourth graders for the M4T classes. While randomization was not feasible during the recruitment process, we were pleased to have two schools in each group and for those schools to have counterbalanced structures. Five of the fourth grade classes, for instance, had classroom rotation similar to five of the fifth grade controls at the middle school. The other two fifth grade controls were at an elementary school that closely related in structure to the fourth grade schools. While the math content the two grades were learning differed in difficulty, the grade-appropriate math performance tests accounted for that. Outside of the intervention, it is relevant to examine whether the other opportunities students had to be active throughout the day impacted the group differences. Five of the math control classes were from a middle school with seven class periods. Every hour the students had three minutes to stand up and walk to their next class. In addition, they had physical education twice a week for 50 minutes but no recess. The other two control classes were from a parochial elementary school with a single teacher for their core subjects and therefore less frequent structured 'movement' between classes. These students had recess one-two times a day for 20 minutes and physical education twice a week for 30 minutes. Similar in most aspects, the

M4T classes had recess every day for 30 minutes, physical education twice a week for 25 minutes, and changed classrooms for their different subjects. Therefore, while we were fortunate the schools we recruited had similar structure and similar time devoted to physical activity, randomization whenever possible is better.

In this project, no comparisons could be made about students' perceptions about need satisfaction right after a traditional lesson versus an integrated one. Future studies should examine how students' situational motivation for an integrated activity compares to their situational motivation to a similar academic concept learned without physical activity. Doing so, would help researchers identify how malleable motivation is at the situational level.

Perceptions of autonomy toward math were difficult to assess in this study and should be interpreted with caution. The lack of reliability within the autonomy items may be due to an inherent lack of choice for school attendance and class participation or perhaps a lack of understanding from this age group regarding feelings of 'pressure'. We were able to use a single item regarding 'choice', but a more specific autonomy measure needs to be developed for elementary age students.

Future studies looking at effects of classroom-based physical activity on motivation and learning should also collect height and weight information. With each child's body mass index (BMI), correlations can be made for the effects on motivation taking into account different body types. In addition, children could be asked their body image perceptions to see if that relates to their true BMI and which correlates more closely to the outcome measures.

### **Conclusion**

From this study we can conclude that short bouts of integrated physical activity in math, improves academic performance on a timed comprehensive math test significantly more than traditional classes. The eight-week intervention may not be long enough to elicit a change in the students' perceptions of their three basic needs in math, yet satisfaction of basic needs is a critical part of students' academic performance. Longer interventions or interventions starting at an earlier age may be necessary to elicit a change in general subject perceptions of competence, autonomy, and relatedness.

Teachers and school administrators are encouraged to seek out ways to incorporate 10-20 minutes of physical activity with their academic lessons at least three days a week. The Move For Thought program did not require extensive training, was well received by principals, teachers, and students, is adaptable for different subject areas and grade levels, and offers an effective means of increasing academic performance and PA minutes while maintaining students' motivation.

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## APPENDIX A

### Factors and Questions used for Basic Need Satisfaction Surveys

#### Math Survey ( $N = 310$ )

##### Factor 1: Perceived Math Competence

- 1. I think I am pretty good in math.
- 7. I find most things are easy to learn and do in math
- 9. When learning something new in math, I know I will be able to learn it well.
- 14. I think I do pretty well in math, compared to other students.

##### Factor 2: Perceived Math Autonomy

- 3. I feel I have some choice over which activities to try to solve in math.
- 10. I feel I am doing only what the teacher wants me to do in math.
- 15. I feel pressure when I am doing activities in math.

##### Factor 3: Perceived Math Relatedness

- 5. I feel involved with my classmates when doing activities in math.
- 11. I feel my classmates care about me.
- 13. I feel emotionally close to my classmates when doing activities in math.

#### Integrated Physical Activity Survey ( $N = 122$ )

*Doing the physical activities in the classroom made me feel...*

##### Factor 1: Perceived IntPA Competence

- 2. That I can do them well
- 6. Competence (have the necessary skill to be successful)
- 10. My skills are improving

##### Factor 2: Perceived IntPA Autonomy

- 3. Pressured
- 7. Free to decide for myself what to do
- 14. I am doing what I want to be doing

##### Factor 3: Perceived IntPA Relatedness

- 4. Involved with my classmates
- 8. Included
- 11. I belong and the people around me care about me



## APPENDIX B

### Teacher Log

TEACHER'S NAME: \_\_\_\_\_ GRADE: \_\_\_\_\_ SCHOOL: \_\_\_\_\_ WEEK: \_\_\_\_\_ TO \_\_\_\_\_

WEEK #	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
Did you use any activities today?	<input type="checkbox"/> YES <input type="checkbox"/> NO If yes, how many? _____	<input type="checkbox"/> YES <input type="checkbox"/> NO If yes, how many? _____	<input type="checkbox"/> YES <input type="checkbox"/> NO If yes, how many? _____	<input type="checkbox"/> YES <input type="checkbox"/> NO If yes, how many? _____	<input type="checkbox"/> YES <input type="checkbox"/> NO If yes, how many? _____
What activity(ies) did you use?	Number: _____	Number: _____	Number: _____	Number: _____	Number: _____
Did you vary it?	<input type="checkbox"/> YES <input type="checkbox"/> NO If so, how? _____	<input type="checkbox"/> YES <input type="checkbox"/> NO If so, how? _____	<input type="checkbox"/> YES <input type="checkbox"/> NO If so, how? _____	<input type="checkbox"/> YES <input type="checkbox"/> NO If so, how? _____	<input type="checkbox"/> YES <input type="checkbox"/> NO If so, how? _____
When was it used?	<input type="checkbox"/> Before 11am <input type="checkbox"/> 11am-1pm <input type="checkbox"/> After 1pm	<input type="checkbox"/> Before 11am <input type="checkbox"/> 11am-1pm <input type="checkbox"/> After 1pm	<input type="checkbox"/> Before 11am <input type="checkbox"/> 11am-1pm <input type="checkbox"/> After 1pm	<input type="checkbox"/> Before 11am <input type="checkbox"/> 11am-1pm <input type="checkbox"/> After 1pm	<input type="checkbox"/> Before 11am <input type="checkbox"/> 11am-1pm <input type="checkbox"/> After 1pm
What was the duration of the activity?	<input type="checkbox"/> 5 min <input type="checkbox"/> 10 min <input type="checkbox"/> 15 min <input type="checkbox"/> 20 min <input type="checkbox"/> 25 min	<input type="checkbox"/> 5 min <input type="checkbox"/> 10 min <input type="checkbox"/> 15 min <input type="checkbox"/> 20 min <input type="checkbox"/> 25 min	<input type="checkbox"/> 5 min <input type="checkbox"/> 10 min <input type="checkbox"/> 15 min <input type="checkbox"/> 20 min <input type="checkbox"/> 25 min	<input type="checkbox"/> 5 min <input type="checkbox"/> 10 min <input type="checkbox"/> 15 min <input type="checkbox"/> 20 min <input type="checkbox"/> 25 min	<input type="checkbox"/> 5 min <input type="checkbox"/> 10 min <input type="checkbox"/> 15 min <input type="checkbox"/> 20 min <input type="checkbox"/> 25 min
How was the experience for you?	<input type="checkbox"/> 1-very bad <input type="checkbox"/> 2-bad <input type="checkbox"/> 3-neutral <input type="checkbox"/> 4-good <input type="checkbox"/> 5-very good	<input type="checkbox"/> 1-very bad <input type="checkbox"/> 2-bad <input type="checkbox"/> 3-neutral <input type="checkbox"/> 4-good <input type="checkbox"/> 5-very good	<input type="checkbox"/> 1-very bad <input type="checkbox"/> 2-bad <input type="checkbox"/> 3-neutral <input type="checkbox"/> 4-good <input type="checkbox"/> 5-very good	<input type="checkbox"/> 1-very bad <input type="checkbox"/> 2-bad <input type="checkbox"/> 3-neutral <input type="checkbox"/> 4-good <input type="checkbox"/> 5-very good	<input type="checkbox"/> 1-very bad <input type="checkbox"/> 2-bad <input type="checkbox"/> 3-neutral <input type="checkbox"/> 4-good <input type="checkbox"/> 5-very good
How was the experience for the students?	<input type="checkbox"/> 1-very bad <input type="checkbox"/> 2-bad <input type="checkbox"/> 3-neutral <input type="checkbox"/> 4-good <input type="checkbox"/> 5-very good	<input type="checkbox"/> 1-very bad <input type="checkbox"/> 2-bad <input type="checkbox"/> 3-neutral <input type="checkbox"/> 4-good <input type="checkbox"/> 5-very good	<input type="checkbox"/> 1-very bad <input type="checkbox"/> 2-bad <input type="checkbox"/> 3-neutral <input type="checkbox"/> 4-good <input type="checkbox"/> 5-very good	<input type="checkbox"/> 1-very bad <input type="checkbox"/> 2-bad <input type="checkbox"/> 3-neutral <input type="checkbox"/> 4-good <input type="checkbox"/> 5-very good	<input type="checkbox"/> 1-very bad <input type="checkbox"/> 2-bad <input type="checkbox"/> 3-neutral <input type="checkbox"/> 4-good <input type="checkbox"/> 5-very good
Any comments?					

## APPENDIX C

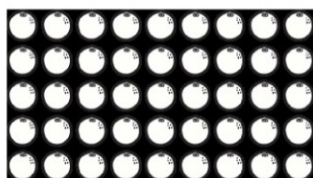
## Comprehensive Fourth Grade Math Test

## Math Numbers Operations and Algebra 4\_2

Student Name: \_\_\_\_\_

Date: \_\_\_\_\_

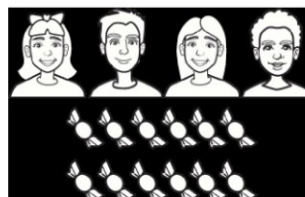
1.



How many oranges in all?

- A. 49  
B. 54  
C. 45

2.



4 kids ate 3 candies each.

How many candies did they eat in all?

- A. 12  
B. 4  
C. 7

3.



A pack of gum has 12 sticks.

How many sticks in 4 packs?

- A. 64  
B. 16  
C. 48

4.

$$\begin{array}{r} 202 \\ \times 3 \\ \hline \end{array}$$

- A. 205  
B. 606  
C. 600

5.

$$2(2 + 8) =$$

- A.  $(2 \times 2) + (2 \times 8)$   
B.  $2 \times 10 + (2 \times 8)$   
C.  $(2 \times 10) + (2 - 8)$

6.

$$332 \times 3 =$$

- A. 996  
B. 335  
C. 665

7.

John sleeps 10 hours a night.  
How many hours does he sleep in 14  
nights?

- A. 180  
B. 140  
C. 80

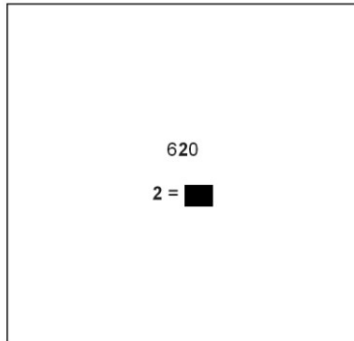
8.

?
42
48

$$? = \blacksquare$$

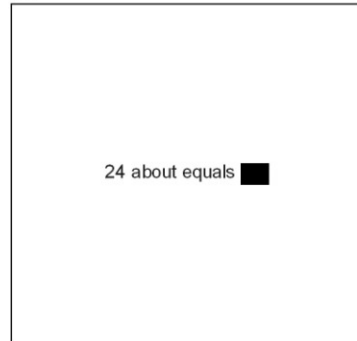
- A. 36  
B. 48  
C. 42

9.



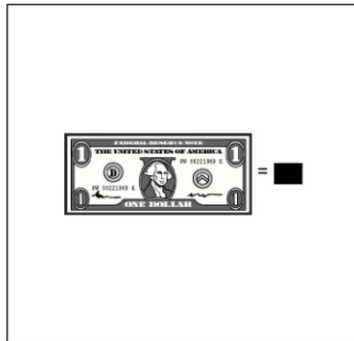
- A. two 10's  
 B. two 100's  
 C. two 1's

10.



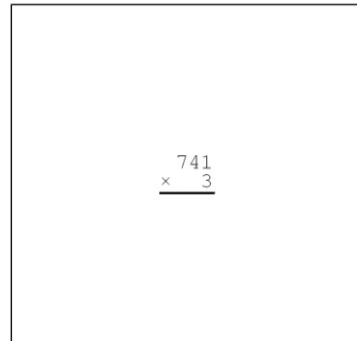
- A.  $5 \times 3$   
 B.  $5 \times 4$   
 C.  $5 \times 5$

11.



- A.  $\$0.10 \times 11$   
 B.  $\$0.10 \times 10$   
 C.  $\$0.10 + 10$

12.



- A. 2123  
 B. 2223  
 C. 2323

13.

74 about equals     

- A.  $25 \times 3$
- B.  $25 \times 4$
- C.  $50 \times 2$

14.

3 TV shows are 90 minutes in all.  
How long are 6 shows in all?

- A. 200 minutes
- B. 100 minutes
- C. 180 minutes

15.

Max's foot is about 12".  
His bike is 5.1 times longer.  
About how long is his bike?

- A. 17"
- B. 72"
- C. 60"

16.

$$\begin{array}{r} 417 \\ \times 2 \\ \hline \end{array}$$

What do you do first?

- A.  $2 \times 41$
- B.  $2 \times 7$
- C.  $2 \times 1$

## APPENDIX D

## Comprehensive Fifth Grade Math Test

## Math Numbers Operations and Algebra 5\_1

Student Name: \_\_\_\_\_

Date: \_\_\_\_\_

1.

Dog Wash	
1 dog	\$4.00
<hr/>	
2 puppies	\$1.75

Dan has \$8.00.

How many times can he wash his dog?

Which answer form is best?

- A. 2 puppies  
 B. \$2.00  
 C. 2 times

3.

There are 21 apples.


7 friends share them evenly.

How many does each friend get?

Which answer form is best?

- A. 3 apples  
 B. 3 friends  
 C. 3 pounds

2.


nickel  = \$0.05

Sal has \$0.25 in nickels.

How many nickels does he have?

- A. 10  
 B. 5  
 C. 4

4.

2 

- A. 22  
 B. 23  
 C. 20

5.

6 tubs hold 125 gallons in all.

About how much does each tub hold?

- A. 20 gallons
- B. 15 gallons
- C. 22 gallons

6.

$$(2 \times 3) \times 6 =$$

- A.  $6 + 3 + 2$
- B.  $(2 \times 6) + 3$
- C.  $6 \times (3 \times 2)$

7.

4 friends walk 12 dogs.

How many dogs does each friend walk?

Which answer form is best?

- A. 3 dogs
- B. 3 friends
- C. 3 walks

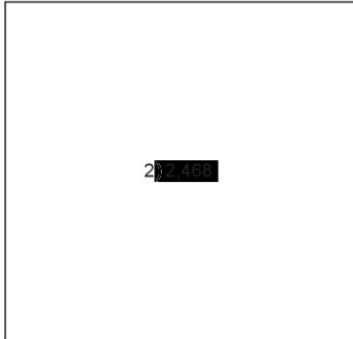
8.

$$6 \frac{7}{8} \div 4$$

What is the first step?

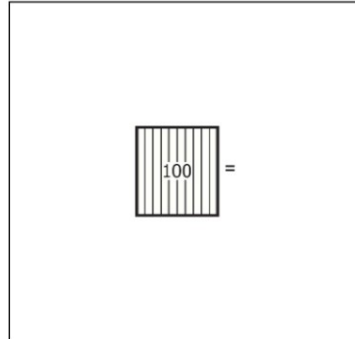
- A.  $4 \div 6$
- B.  $7 \div 6$
- C.  $6 \div 6$

9.



- A. 1,234  
B. 36  
C. 1,212

10.



- A. 100,000  
B. 10,000  
C. 1,000

11.



- A.  $15 \div 5$   
B.  $55 \div 5$   
C.  $1 \div 5$

12.

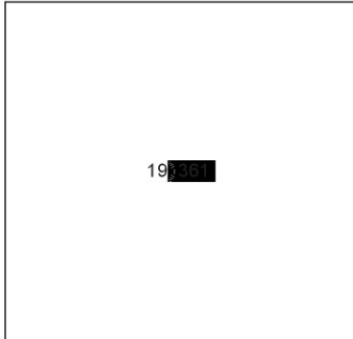
	$\div 2$	$\div 3$
\$6.00	\$3.00	\$2.00
\$12.00	?	\$4.00
\$18.00	\$9.00	\$6.00

? =       

- A. \$6.00  
B. \$8.00  
C. \$4.00

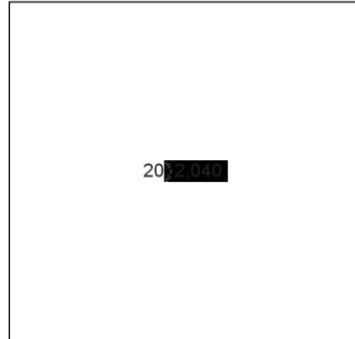


13.



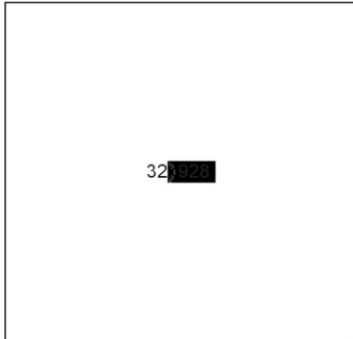
- A. 19  
B. 20  
C. 1

14.



- A. 22  
B. 202  
C. 102

15.



- A. 29  
B. 39  
C. 22

16.

There are 12 cakes.  
4 friends share them evenly.  
How many does each friend get?  
Which answer form is best?

- A. 3 pounds  
B. 3 cakes  
C. 3 answers

## **APPENDIX E**

### **Move for Thought Kit**



## ove for Thought

*Integrated Physical  
Activities for Learning  
in the Elementary  
School Classroom*



### **"Move for Thought"**

#### **Integrated Physical Activities for Learning in the Elementary School Classroom**

The **"Move for Thought"** Kit can be used to assist in meeting your Healthy Kids Act physical activity minutes and your Healthier US School Challenge physical education minutes (if planned in partnership with the physical education teacher).

The project was funded by a Team Nutrition grant from the United States Department of Agriculture.

The **"Move for Thought"** Kit was developed by Spyridoula Vazou, Ph.D. (Department of Kinesiology, Iowa State University). Dr. Vazou teaches Elementary PE and her research focus is on motivating children to be physically active inside and outside the classroom.

To print copies of the kit, the electronic version can be found at: *(website to be added soon)*.

#### **Federal Civil Rights Statement**

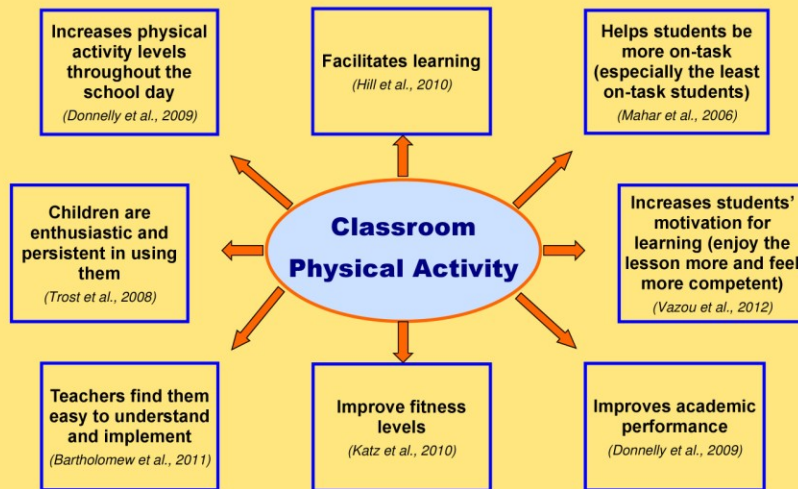
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It is the policy of the Iowa Department of Education, Bureau of Nutrition, Health and Transportation Services not to discriminate on the basis of race, creed, color, sex, sexual orientation, gender identity, national origin, disability, or religion in its programs, activities, or employment practices as required by the Iowa Code section 216.7 and 216.9. If you have questions or grievances related to compliance with this policy by the Iowa Department of Education, Bureau of Nutrition, Health and Transportation Services, please contact the Iowa Civil Rights Commission, Grimes State Office Building, 400 E. 14th St., Des Moines, IA 50319-1004; phone number 515-281-4121, 800-457-4416; web site: <http://www.state.ia.us/government/crc/index.html>.



## Why include physical activities in the academic classroom?



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## A few words about the activities...

- All activities were developed with the goal of being easy and safe to apply in a classroom with limited space, equipment, and preparation time.
- All activities were developed to be integrated with the content of **ANY** subject area. The teacher will only need to prepare the academic content that will be used for each activity, e.g., on flashcards, a whiteboard, or clipboards. Modification of the activities to fit the teacher's needs is encouraged.
- All activities target aerobic fitness to some extent. In other words, on average, they are physical activities of moderate intensity (such as brisk walking).
- All activities were developed with the goal of promoting intrinsic motivation (*e.g., do them because they are fun and help me learn and improve*) as well as perceptions of self-oriented competence (*i.e., I feel I can do them correctly without worrying about how everyone else is doing*) for both physical activity and academic learning in the classroom. Such an approach may help children adopt a lifelong physically active lifestyle, as well as a continuous desire for learning.
- The "Move for Thought" kit was not developed as a replacement for physical education. It was designed to help children increase their physical activity levels during the school day, as well as to help teachers facilitate learning and academic achievement.

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## Teaching Tips

Before the beginning of each activity, a short warm-up will prepare the children both physically and mentally. You may do:

- ▶ stretching poses (standing or sitting on a chair), such as extend arms overhead and sideways, twist your body
- ▶ whole-body routines, such as march in place, jog in place with heels back or knees up
- ▶ strength activities, such as bending knees, extend legs to the sides, arm circles to the sides

A short cool-down (such as a few deep breaths and stretching poses) will also help the children have an easier transition back to their desks.

Try to use the activities on a daily basis, based on your comfort level. Target about **10 minutes** during a lesson to implement one activity. Start with easier versions of the activities and make them more challenging as students learn them.

Additional online resources can be found at: <http://www.emc.cmich.edu/BrainBreaks/> (Brain Breaks)  
<http://www.ncpe4me.com/energizers.html> (Energizers)  
<http://schools.nyc.gov/Academics/FitnessandHealth/MoveImprove/default.htm> (Move to Improve)  
<http://www.jamschoolprogram.com> (JAM; Just-a-Minute)

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## What I should know about physical activities

▶ There are different ways a body can move, from one place to another, or in one spot. All the ways the body can move are called fundamental motor skills. The skills that are required in order to move from one place to another are called “locomotor” skills. All 8 basic locomotor skills plus additional animal moves are described in the table that follows.

▶ A body can also move from a relatively stable position (nonlocomotor skills). Examples include: bending and stretching, pushing and pulling, twisting, shaking, and circling body parts.

▶ Lastly, the skills that require manipulation of an object with some part of the body (e.g., throwing, catching, rolling, dribbling, striking) are called “manipulative” and are the most complex and often most difficult for children to learn.

▶ To increase the “movement vocabulary” and challenge children, you can change the *space* (self and general space), the *directions* (e.g., forward, backward, sideways), the *levels* (high, medium, low), the *pathways* (e.g., straight, curved, zigzag), the *speed* (slow, fast), and the *relationships* (e.g., to others, to objects – move over, under, around, on, off, near, between, mirroring).

▶ By changing the “movement vocabulary,” you can have a wide variety of modifications on the same activity that will keep the students engaged and will help them improve their motor skills.

▶ The fundamental motor skills are the foundation for a child’s development. A solid foundation can help children enjoy physical activities and adopt a lifelong physically active lifestyle.

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## Some examples of how we can move

• Walking	One foot is always in contact with the ground.
• Marching	Is a rhythmic walk accompanied by lifted knees and swinging arms.
• Running	Varies from slow jog to sprint. Both feet are off the ground briefly.
• Jumping	Is taking off from 2 feet and landing on 2 feet with bent knees.
• Galloping	Step forward with the other foot following. The same foot always leads.
• Sliding	Is similar to galloping but the direction is sideways. Feet don't cross.
• Hopping	Is done from one foot to the same foot. Arms help balance.
• Leaping	From one foot to the ball of the other foot with a springing action.
• Skipping	A combination of a long step with a short hop, alternating the lead foot.
• Bear walking	Lumbering with hand and foot on the same side going forward together.
• Crab walking	On the hands and feet with stomachs pointed toward the sky.
• Rabbit jumping	Transfer weight from feet to both arms and jump with both feet close to the arms.
• Frog jumping	Deep jumps from 2 feet to 2 feet. Jump high and then squat to the floor.
• Kangaroo jumping	Small consecutive jumps while holding hands near chest.
• Imaginary walking	Walk like a robot, an earthquake, on ice, on fire, etc.

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## Table with activity characteristics

Activity	In limited space	In general space	With a group	Individually	Low to moderate intensity	Moderate to vigorous intensity	Equipment
1. Curious Ball		x	x		x		Ball
2. Move Around		x		x		x	Flash cards
3. To the Wall		x	x	x		x	Chalk or tape (optional)
4. Red Light, green Light	x			x	x		None
5. Over and Under		x	x			x	Balls or beanbags
6. Jump in Hoops	x		x		x		Hula hoops
7. Animal Track		x	x			x	Flash cards, boxes (optional)
8. Jump the Answer	x			x		x	Poly spots, tape (optional)
9. Messed-up Train	x		x		x		Flash cards, chalk
10. Find your Pair		x	x		x		Flash cards

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# How to use these cards

**Title**

**Suggested sample psychomotor outcomes of the activity**

**Description of the activity**

**Provides tips for adjusting the level of difficulty to make it appropriate for younger children**



**MISSION:** 1. Curious Ball

**OBJECTIVES:**

- successfully pass and catch a ball with both hands
- demonstrate understanding of space awareness and effort (quick reaction and movement time)

Each group has a ball that has numbers on it. Each number corresponds to a question that is written on the board (or a list that is read to the group by a helper.) A student passes the ball to another student. The one who catches the ball looks at the number that is under the left thumb, reads (or listens to) the question and answers. Next, he/she passes the ball to another student who again answers the question that corresponds to the number under the left thumb.

**VARIATIONS FOR YOUNGER CHILDREN:**

- Arrange the children in two lines facing each other and ask them to pass the ball to the child across from them.
- In the circle formation, the teacher may stand in the center of the circle and pass the ball to one child who will answer the question and pass the ball back to the teacher.
- Passing can be replaced with rolling on the floor, and balls can be replaced with beanbags. Changing the size of the ball can also modify the difficulty level of the activity. Smaller balls are harder to catch.
- To increase the energy expenditure, after returning the ball, children can run around, outside the circle, and return to their initial position.


**EXTRA TIPS:**

- To challenge students, add the action "run where you pass the ball". After passing the ball to X, I run and stand where X was standing. X, after answering the question, passes the ball to Y and runs to stand where Y was standing. Y continues by running towards the child who receives the ball, and so on.
- Timing the activity until all children in the circle have passed the ball successfully is another challenge for the children. Compare their time with their previous performance and roll with the time of the other groups. Repeat a few times and find the fastest time.
- Useful rules & cues: don't pass the ball to the child next to you, don't pass too hard, don't pass to the same child two consecutive times, make sure the receiver watches you before you pass.

**ORGANIZATION**

Materials: ball (or numbered from 1 to N)

Set up: small groups of children (6-8) are placed in a circle formation.



**Management tips before the beginning of the activity**

**Visual formation in the classroom.**

**X = children**

**T = teacher**

**● = study cards, ● = ball**

**Teaching tips to enhance success of the activity**

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## ove for Thought

### ACTIVITIES



College students demonstrate and practice the "Move for Thought" activities.

**TEAM NUTRITION IOWA™**

## TEAM NUTRITION IOWA™

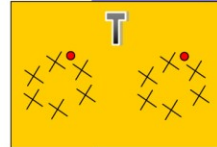


### MISSION: 1. Curious Ball

- OBJECTIVES:**
- successfully pass and catch a ball with both hands
  - demonstrate understanding of space awareness and effort (quick reaction and movement time)
- Students will be able to

Each group has a ball that has numbers on it. Each number corresponds to a question that is written on the board (or a list that is read to the group by a helper.) A student passes the ball to another student. The one who catches the ball looks at the number that is under the left thumb, reads (or listens to) the question and answers. Next, he/she passes the ball to another student who again answers the question that corresponds to the number under the left thumb.

- ORGANIZATION**
- Materials:** ball (s) numbered from 1 to N
- Set up:** small groups of children (6-8) are placed in a circle formation.



### VARIATIONS FOR YOUNGER CHILDREN:

► Arrange the children in two lines facing each other and ask them to pass the ball to the child across from them. ► In the circle formation, the teacher may stand in the center of the circle and pass the ball to one child who will answer the question and pass the ball back to the teacher. ► Passing can be replaced with rolling on the floor, and balls can be replaced with beanbags. Changing the size of the ball can also modify the difficulty level of the activity. Smaller balls are harder to catch. ► To increase the energy expenditure, after returning the ball, children can run around, outside the circle, and return to their initial position.

**EXTRA TIPS:** ► To challenge students, add the action "run where you pass the ball". After passing the ball to X, I run and stand where X was standing. X, after answering the question, passes the ball to Y and runs to stand where Y was standing. Y continues by running towards the child who receives the ball, and so on. ► Timing the activity until all children in the circle have passed the ball successfully is another challenge for the children. Compare their time with their previous performance and not with the time of the other groups. Repeat a few times and find the fastest time. ► Useful rules & cues: don't pass the ball to the child next to you; don't pass too hard; don't pass to the same child two consecutive times; make sure the receiver watches you before you pass.

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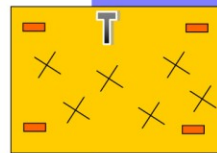


### MISSION: 2. Move Around

- OBJECTIVES:**
- move in general space avoiding others
  - successfully use 2 different locomotor skills in general space
- Students will be able to

Students are given a "move" (e.g., skipping). Flash cards with questions are placed in piles on designated areas. On a "go" signal, students move around the space. On a "Stop" signal, they pick up a card from a pile closest to them and continue doing the "move" in place. The teacher moves around and checks the answers (verbally or written). Next, cards are placed back in the stacks and a new "move" is assigned. On signal, students collect another card, continue the "move" and answer the question until the next signal.

- ORGANIZATION**
- Materials:** flash cards, music (optional)
- Set up:** Scattered formation



### VARIATIONS FOR YOUNGER CHILDREN:

► Ask children to extend their arms while moving around as if they are in a bubble. Emphasize that they don't want to pop their bubble. ► Skipping is a skill that some younger children may have difficulties in performing. Start with easier moves, such as walking, sliding or galloping, at a slow speed. ► Have flash cards with different colors and write one problem on all the cards with the same color. Ask the children every time to collect a card with a different color. End the game when all different cards are collected.

**EXTRA TIPS:** ► To avoid collision, place the cards in several different spots or scattered around the classroom. ► Ask students to place the cards facing down (for random selection of cards). ► Give the students the option to choose among 2 or 3 different "moves". ► Emphasize keeping the head up to avoid others. ► Challenge them to modify the speed they move but still keeping their personal space intact. ► Instead of a verbal signal, music can be used. When music starts students "move" and when it stops they take a card.



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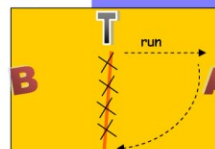


### MISSION: 3. To the Wall

- OBJECTIVES:**
- show readiness and demonstrate understanding of reaction time
  - use at least two different locomotor skills in specific pathways

The teacher explains what A and B represents. For example, A = odd number and B = even number, in a math activity; A = noun and B = verb, in Language Arts; or A = lake and B = river, in Social Studies. The teacher asks a question to the first child in line. The children then runs to the side of the wall (A or B) based on their answer. Teacher will confirm if answer is correct and then the child goes to the end of the line. The activity repeats with the next child in line, using a new question.

- ORGANIZATION**
- Materials:** a list with questions, chalk/tape
- Set up:** draw a line with chalk, tape or use an existing line in the classroom



### VARIATIONS FOR YOUNGER CHILDREN:

- Statement can be used instead of questions (such as true or false; greater than or less than) or show two pictures with one correct and one wrong answer.
- For every question or statement, all children simultaneously move to the correct wall to provide the answer and back to the line.
- Moves of slower speed, like walking, galloping or skipping can be used instead of running.

- EXTRA TIPS:**
- The first child in line is the leader and may select the way of moving (e.g., instead of running, jumping or skipping). The A new leader (+movement) is set every 10th child.
  - You can set some group goals, like "how many students can complete the activity within one minute", and compare the group performance with previous ones. The next child starts when the preceded child touches the wall.
  - To maximize participation, (a) children standing in line can perform an assigned movement, such as squats or jumps over the line, (b) if an assistant is available, two lines facing toward the opposite walls can play simultaneously.
  - To avoid collision, put a mark as a start point and let the child run to you in order to get the question (that way every child doesn't feel embarrassed if the answer is wrong).

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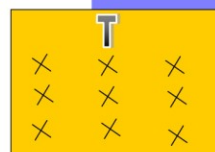


### MISSION: 4. Red Light, Green Light

- OBJECTIVES:**
- successfully balance after a movement (hold it for 3 sec)
  - use their imagination and do various shapes in a balanced position

The teacher says what "red light" might be, such as, a noun in Language Arts; an even number, in Math; a false statement in Social Studies. Children do the assigned movement as quickly as possible (e.g., jog in place, knees up, jumping jacks) and the teacher reads the passage. When the students hear the "red light" word they need to stand very still in a balanced shape of their choice. With the signal "green light" children move again until they hear the next "red light" word from the teacher.

- ORGANIZATION**
- Materials:** none
- Set up:** standing next to their desk or scattered in open space



### VARIATIONS FOR YOUNGER CHILDREN:

- Use a visual signal (e.g., a signal with the "red light" word) when reading the passage. A warning before the "red light" word may be also helpful to hold their attention.
- At the first attempts, give specific instructions for the shapes. For example, "next time, can you make a tall and narrow shape?", or "can you make a shape when balancing in 3 body parts?"
- Before the beginning of the activity, ask some children to demonstrate a successfully balanced shaped and initiate a short discussion about balance.

- EXTRA TIPS:**
- A useful cue for balance is "squeeze your muscles" and "hold it for 3 sec"
  - Give the students the option to choose among 2 or 3 different movements.
  - Praise students' creativity and challenge them to find unusual shapes to balance.
  - Shapes with a partner increase the difficulty of the activity and challenges them to be more creative.
  - Make sure every child has enough personal space to avoid collision.

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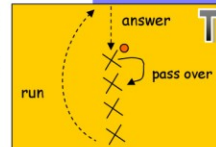


### MISSION: 5. Over and Under

- OBJECTIVES:**
- manipulate an object in at least two different directions
  - practice lateral movements with body and hands
  - work on flexibility and balance

The first child in line bends backwards and passes the ball over the head to the child behind him/her. The next child passes the ball through his/her legs to the next child. The last child in line goes to the board, picks up a card with a question and places it in the correct bucket or pile (either true or false). The child then goes to the front of line and starts the activity over again. Repeat until all children have answered one (or more questions). After the activity is completed as a class, go through the buckets or piles and decide if the cards were placed correctly.

- ORGANIZATION**
- Materials:** balls
- Set up:** A group of children line up with legs shoulder-width apart.



### VARIATIONS FOR YOUNGER CHILDREN:

- Instead of balls, beanbags, or small paper balls can be used.
- To make the activity more challenging, ask the child who carries the beanbag to the front of the line, to walk while balancing it on the head.
- Use only one pattern of movement each time. For example, everybody passes the beanbag over the head.
- Create more lines with 3-4 children, shaped in a circle around you and verbally state the question once the children come close to you.

- EXTRA TIPS:**
- You can set some team goals, such as "Let's see, as a team, how fast you will finish the activity. Next time, can we try to be a little faster?"
  - For variety, modify the passing pattern. Examples of more advanced patterns are (a) twist the body and pass it with two hands in a standing position (b) circles around the legs in Figure 8 and pass in between the legs, (c) around the waist making a full circle and pass over the head.
  - Instead of running to the board, children can move using different locomotor skills, such as jumping, crab-walking (while balancing the ball on the stomach).
  - Put a mark on the floor for a starting point.

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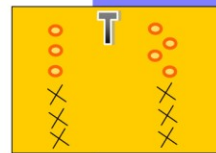


### MISSION: 6. Jump in Hoops

- OBJECTIVES:**
- demonstrate hopping (one foot) with control five times on right and left foot.
  - jump with two feet and land quietly without losing balance

The teacher places on the floor as many hoops as the categories he/she has selected (for example, multiply by 1, 10, 100, 1000 in math; simple, comparative, superlative form of adjective in English Arts; people, places and environments in Social Studies). Each child needs to name one item of the category while jumping from one hula hoop to the other. While inside a hoop, the child needs to hop for 5 times on one leg. Switch legs after every jump. After completing the path, the child goes back to the end of the line.

- ORGANIZATION**
- Materials:** hula-hoops
- Set up:** Lined up in groups of four to six children



### VARIATIONS FOR YOUNGER CHILDREN:

- Ask them to bend knees, swing arms and land as quietly as they can.
- Use smaller hoops or poly spots to decrease the distance between the jumps. With the poly spots you may have more space available to create smaller groups of children (three to four).
- Start with jumping (two feet) and only once all of them are successful, make the activity more challenging with more complex movements.

- EXTRA TIPS:**
- Ask children not to repeat an item that has already been said.
  - Distribute answer sheets and ask the child who is last in the line to write down the answers of the preceding child.
  - Challenge them to find different ways to travel over the hoops, such as, in different directions (e.g., forward, backward, sideways), patterns (e.g., jump, jump, hop), locomotor skills (e.g., slide, leap, skip), pathways (e.g., zigzag, circle) or distances (placing the hoops further away or closer).
  - Challenge them as a group to find as many answers as possible. Switch groups regularly.
  - Vary the size of the groups based on all the possible items in each category.



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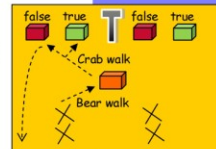


### MISSION: 7. Animal Track

- OBJECTIVES:**
- demonstrate at least two different animal moves
  - use their imagination and creative expression
  - improve upper and/or lower body strength and coordination
- Students will be able to

The first child in each line bear-walks to the box with the statements, selects a card and then crab-walks to the true and false boxes. The card is transferred to the correct box by being placed on the child's belly. Next, the child goes to the end of the line with another assigned move (e.g., frog jump, galloping, or skipping) while the next child starts. The teacher checks the answers throughout the activity.

- ORGANIZATION**
- Materials:** flash cards & boxes (optional)
- Set up:** lined up in small groups (based on space)



### VARIATIONS FOR YOUNGER CHILDREN:

Use one pattern of movement throughout the path, or combine one animal walk with a simple locomotor skill (such as walking, or galloping). ► Use pictures with the content you want younger children to practice. ► Before the beginning of the activity, ask children to demonstrate different animal walks (e.g. penguins, elephant, kangaroo). Let them choose the moves they want to include.

**EXTRA TIPS:** ► Pencils can be placed next to the problem box, for students to write the correct answer if the given answer is incorrect. ► To make it more challenging, the activity can be timed and the goal may be to compete the time of the previous performance, as a team. Time, as well as number of correct answers can be counted. ► Once the activity is completed, ask the teams to score their box with the correct and wrong answers. ► Emphasize "flat stomachs" during crab walk to balance the cards, and "keep their head up" during bear walks. ► To increase safety, make sure the moving paths for each group are free from obstacles and children have enough space to move. ► Put a mark on the floor for the starting point.

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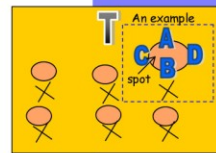


### MISSION: 8. Jump the Answer

- OBJECTIVES:**
- perform an aerobic routine without stopping, for at least X sec\*
  - jump with two feet forward, backward and on the sides
- Students will be able to
- \* set goals depending on their age and fitness level

Pass out poly-spots for each student or use tape to create a spot for each student. The teacher has created questions with four possible answers for each question. Children need to jump with two feet over the spot on the correct side (forward = A, backward = B, left = C, and right = D) and continue jumping in place for 10 (or more) times. Next, children need to crisscross jump while waiting for the teacher to go around and check each child's answer. After the answers have been checked, the teacher asks the next question.

- ORGANIZATION**
- Materials:** poly-spots, or tape to create the signs.
- Set up:** standing on a spot next to their desk.



### VARIATIONS FOR YOUNGER CHILDREN:

► Use visual aids with the answers. ► Instead of four, two possible answers or two kind of statements (e.g., true-false, positive-negative) can be provided. Children can jump continuously forward and backward for option A and right and left for option B. ► Provide frequent short breaks for stretching or deep breathing. Aerobic capacity is limited in younger children. ► Emphasize soft landing by bending their knees.

**EXTRA TIPS:** ► You may use tape to create a personal grid for each child. ► To make it more challenging, children can use their chairs. Start by standing in front of the chair, bring arms back and hold the sides of the chair, support your weight with your arms and jump. ► Let children choose among different moves (of varying intensity level, e.g., march, criss-cross or tap toes), while waiting for the next question. ► You may distribute different lists with questions in the class and ask them to work on their own by jumping the answer before they write it down on their answer sheet. Whole children practice you move around and check the answers.

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### MISSION: 9. Messed up Train

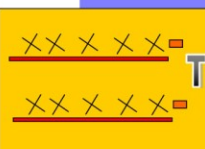
- OBJECTIVES:**
- Students will be able to
    - cooperate with at least three members of their team in finding a solution to a problem
    - do at least two successful balances while using imagination

Children are lined up and are asked to have at least one foot on the line. The teacher has created stack of cards, with one letter in a card. Equal number of children and cards should be in each line. The teacher gives the child first in line a stack of cards. The child takes one card and passing rest back to the children behind them in the line. Children, without talking, need to find the correct sequence (e.g. spelling of a word or order of numbers, largest to smallest) always leaving at least one foot on the line.

### ORGANIZATION

**Materials:** flashcards, chalk/tape

**Set up:** draw a line with chalk, tape or use an existing line in the classroom



### VARIATIONS FOR YOUNGER CHILDREN:

- To increase the available space that children will have to move, either use squares or create an area (shaped by two parallel lines) inside of which children can move.
- Use shorter words (less cards) with younger children and guide them (by asking questions) to find the solution.
- You may write the content of the cards (in the same order as distributed) on the board for a visual aid.

- EXTRA TIPS:**
- Children are not allowed to pass their card to another child. Instead, they need to move with their card to the correct position.
  - To make it more challenging, you may want to use specific time limits in order to find the solution and be placed in the correct spot on the line.
  - Change the groups often.
  - To increase the difficulty level, the cards may contain questions or math problems, the answers of which need to be placed in the correct order (from smaller to bigger, or in an alphabetical order).
  - Create lines of different heights (e.g. using low balance beams) to increase the difficulty level of the activity.

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### MISSION: 10. Find your Pair

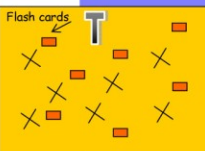
- OBJECTIVES:**
- Students will be able to
    - successfully demonstrate at least one shape with a partner
    - move around while avoiding others
    - cooperate well with all classmates

The teacher randomly places the cards around the classroom, on desks, chairs or on the floor (on spots to avoid fallings). With the signal, all children move around the classroom with a pre-assigned move (e.g., skipping). With a second signal, all children collect the card closest to them and, without talking, need to find the matching card. Once the children have found their pair, they continue the pre-assigned activity (e.g. skipping) with their partner. The teacher moves around and checks the paired cards. Next, cards are placed back (facing down) and with a new signal children start moving around.

### ORGANIZATION

**Materials:** flashcards; half with questions & half with answers

**Set up:** scattered formation



### VARIATIONS FOR YOUNGER CHILDREN:

- Use two different colors of flashcards, one for the questions and one for the answers.
- When paired, children can do some matching and mirroring activities, such as, while facing each other, partner 1 makes a shape and partner 2 tries to copy it exactly. Mirroring means that partner 2 makes the same shape, only opposite (like looking in a mirror).
- Partner challenges could also be used, such as: (1) facing each other, arms on shoulders, try to slide to the side and back, (2) facing each other, make a bridge with your arms. Matching is the easiest activity and partner balance is the most advanced.

- EXTRA TIPS:**
- Examples of partner challenges are: (1) from sitting position with backs together and arms hooked at the elbows, try to sit down together and standup, by pressing the backs together (2) facing each other with hands joined, lift both arms on one side and rotate bodies by turning in the direction of the lifted arms, and return to the starting position.
  - Encourage them to find their own partner challenge, and matching/mirroring shapes or moves. Give the option to choose between a matching shape, a mirroring shape (without a body contact) and a partner challenge (with body contact).

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**Note:** The pictures were taken during a University course that integrated physical activities with academic subjects in 2009. The pictures were taken by Dr. Spyridoula Vazou, who developed and taught the course, with permission from all students.